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CONTENTS.

Editorials 1333
Street-Lighting Tables 1336
Recommendation of Award of Edison Medal to George Westinghouse 1336
A. I. E. E. Meeting and Smoker 1336
The American Institute of Electrical Engineers and Water-Power Development 1336
Magnification of Electric Currents 1339
Tubular Tungsten-Lamp Filament 1340
Milwaukee's Electrical Industry 1340
Railway Telegraph Superintendents at Chicago 1341
Underground Electrolysis in Chicago 1342
Talk on Investments by Mr. Henry L. Doherty Before New York Electrical Society 1343
Valuation of Public-Utility Properties 1344
Electric-Service Rates and Municipal Ownership 1345
Public Service Commission News 1346
Current News and Notes 1347
The New York Public Library 1351
An Oil-Engine Central Station 1356
Miniature Hydroelectric Plant at Springfield, Vt. By M. A. Hicks. 1358
Efficiency of "Earths" in Radiotelegraphy. By Charles A. Culver. 1360
Reinforcement of Direct-Current Three-Wire Feeders. By A. W. Welch 1361
Some Notes on European Three-Phase Gas-Engine Plants. By Warren H. Miller 1363
Points of Interest in Layout of New Turbine Station for Lexington, Ky. 1365
Handling Lumber by Electricity. By E. L. Barnett 1366
Water-Supply Situation of Louisville Central Station 1367
Conveyor Systems for Handling Coal. By Henry J. Edsall 1368
Improving Fire-Room Efficiencies 1369
Letters on Practical Subjects 1371
Questions and Answers 1375
Grounding Secondaries at Denver 1380
Bottle Electric Tower 1382
The Lighting of Railroad Stations 1383
LETTERS TO THE EDITOR:
Soldered Wire Connections. By F. P. Kenny 1385
Registering Maximum Demand. By Cecil W. Brown 1385
Digest of Current Electrical Literature 1386
Book Reviews 1390
New Apparatus and Appliances 1391
Industrial and Commercial News 1396
General News 1400
Directory of Electrical Associations, Societies, etc 1407
Weekly Record of Electrical Patents 1408

THE NATIONAL WATER-POWER SITUATION.

The present discussion of the whole water-power situation before the National Waterways Commission is an event of no small public importance, since upon the decisions reached will rest in large measure the policy of the next few years with reference to the utilization of the hydraulic resources of the country for the benefit of its people. It was a wise and proper thing for the commission to invoke the counsel of the American Institute of Electrical Engineers, in the hands of whose members rests for the most part the evolution of hydroelectric systems. The Institute, as President Dunn pointed out, is not a commercial body, but an organization for scientific and professional ends, and hence its suggestions could not properly take cognizance of the political and legal questions which are conspicuously to the front in the present discussion. Its proper function was merely to define the situation from the standpoint of those whose work it is to utilize the national hydraulic resources in the fullest and most complete way for the service of the public. Looking at the matter in its largest aspects, the great fundamental fact is that every cubic foot of water which tumbles seaward unutilized represents definite monetary loss to the nation. More than this, it implies continuing depletion of the coal supply, upon which the inroads of industry year by year are growing more and more formidable. It is no place here to discuss the magnitude of the total coal supply or the probable date of its complete destruction. It is enough to realize, as every thinking person must, that at the rapidly increasing rate of consumption now evident the cost of fuel must probably even in the lifetime of persons now living be very seriously increased by the combined effects of scanty supply, increasing distance of transportation and exigencies of deep mining. Hence the prompt utilization of water-powers running to waste must be looked upon in the light of a public necessity. Therefore, it is the plain duty of the government to avoid obstructive measures. To delay the utilization of water-powers for a generation means loss and not gain, for these powers will be none the greater through enforced idleness for a quarter or half a century. The Secretary of the Interior in addressing the National Waterways Commission the other day laid proper emphasis on these facts and called for a speedy agreement on a general policy that will encourage developments.

The brief submitted by the committee of the American Institute of Electrical Engineers is a specially valuable contribution to the discussion in that it calls attention to the nature of hydroelectric enterprises, and especially to the all-important fact that in such undertakings the capital charges are the chief and controlling items of expense. By reason of this fact any regulations that increase the

difficulty of getting capital at a reasonable rate of interest, that decrease its security when invested, or that hamper it with restrictions which compel large charges for sinking fund and similar expenses, are certain to increase the necessary price of electrical energy to consumers and may even, from the competition due to fuel, actually check developments altogether. The balance as between power derived from hydroelectric installations and that generated in modern steam plants is sometimes a rather delicate one, easily overset by even comparatively small additions to the fixed charges, which already represent a very large percentage of the possible earnings. The consumer does not care who is the ultimate owner of a water-power, but is interested only in securing a reliable power supply at a moderate cost. We take it that the chief function of the Waterways Commission is to formulate regulations insuring certainly to the people such utilization of water-powers as shall bring them precisely this advantage. So long as this end is secured we do not see the least reason for statutory enactments to prevent a large number of water-powers being utilized by the same enterprising persons. Electric supply is not a naturally competitive business, particularly if from hydroelectric plants, since it is perfectly certain as a matter of engineering that two hydroelectric systems operating in the same territory independently could be worked more economically by a physical consolidation, avoiding unnecessary duplication of lines and gaining the well-known advantages to be derived from operating a group of stations as a dynamical system.

A natural monopoly doing public service in virtue of public franchise is admittedly a proper subject for governmental regulation and control, and if this is properly exercised the consumer has no reason to fear the results. Nor is there any reason for granting franchises limited to a relatively short term if the right is reserved by the government of complete regulation, including adjustment of price at not infrequent intervals. A lease the value of improvements upon which may be extinguished in twenty-five or fifty years by limitation implies in some form extra fixed charges which must ultimately come out of the consumer, and if the government possesses the right of regulation and control of price, it makes not the slightest difference either to the government or to the consumer over whom these rights are actually exercised. Admitting such control, no one is the gainer by change of ownership or the loser by its continuance. As the ultimate object of control is to secure moderate and equitable prices to the consumer, the furthest length to which, in our view, the government is justified in going in the control and regulation of the sources of capital involved is to take rigorous measures to insure that water-powers shall not be exploited for speculative purposes and thereby burdened with interest charges on a fictitious capitalization. It must be admitted that the danger of this is considerable and that the government is fully justified in making stern regulations against it. If the ostensible investment in a particular proposition is $10,000,000, the apparently necessary fixed charges will be at least double those incurred if the actual capital is but $5,000,000, and the money necessary to pay the additional charges is necessarily derived from the consumer. In the interest of the public, therefore, the government is fully justified in insisting that its lessees shall build so as to keep their fixed charges down instead of piling them up.

The only conspicuously weak spot in the brief of the American Institute was the tacit assumption that water-powers should be financed as they very commonly have been in the past, the constructions being wholly on borrowed money and no profit being ostensibly received until a fair rate of interest on the entire capital investment has already been paid. We do not believe it to be wise for the government to encourage a method of exploitation which expects to derive from the lease ample interest on double the real investment, unless the total interest charges are limited to a sum which is a fair return on the investment, considering the circumstances under which it is made. Everybody realizes that industrial investments involve risks, some of which were admirably pointed out in the Institute brief, and deserve a more liberal return than one would expect to get, for instance, on government bonds or high-grade railway securities. On the other hand, many a plant now in existence ought to be reckoned as financially prosperous if it is paying, with a comfortable margin for sinking fund and renewals, 6 per cent interest on its bonding issue, which very likely represents at least 25 per cent to 40 per cent more than the necessary actual expenses of the development. In other words, the question may legitimately arise as to whether those people who have really invested money in such a plant can reasonably expect more than 8 or 10 per cent. It does not make any particular difference in the long run by what devices a reasonable rate of profit is secured, but it is certainly the duty of the government to see that the rate is open and above-board and fair to all parties concerned.

As regards consolidations, it seems to us that the government should pursue a very liberal policy so long as it has the ultimate control. As we have many times shown, physical consolidations uniting isolated enterprises into a coherent network are a very great benefit and ought to be encouraged. Consolidations involving common ownership without competitive union are, assuming government regulation, entirely harmless and at times beneficial. The only form of consolidation which the government should look out for and suppress is such corporate consolidation as unites plants, not so much for the purpose of economical administration, as to furnish a basis for the flotation of additional securities, the interest charges of which must be saddled on the consumer whom the government is undertaking to protect. It is not a good thing for the public if the earnings of the prosperous members of a consolidation must be kept up at the expense of the community to give a fictitious value to the securities issued on the cats and dogs of the organization somewhere else. In short, the more the government encourages legitimate consolidations free from the taint of high finance the sooner will the hydraulic resources of the country be properly and efficiently developed. The substance of the whole matter is that the government ought to adopt the most liberal policy with respect to leases and ownership, while holding with the utmost tenacity to its power of control and of regulation.

REINFORCEMENT OF DIRECT-CURRENT, THREE-WIRE FEEDERS.

One of the perpetually recurring problems calling for the attention of central-station managers and engineers is what size of conductor to provide for the delivery of a given load or combination of loads. This problem reaches its most acute and aggressive stage at the installation of the conducting system, when the station is first set in operation; but it seldom fails to resurrect itself, like Banquo's ghost, at odd and inconvenient moments. The load on the system grows, and the feeders originally provided cease to be adequate. New mains and feeders must be bought and laid. How large are the new feeders to be? If the prospects are in favor of a continued increase in load, why not purchase and lay extra feeders, large enough to provide a margin for future growth? But how much margin should be provided, for margin means investing capital that for the moment is unproductive? If some benevolent intelligence in the alleged spirit world would accurately predict for us the increase of load that the new feeders would have to carry, month by month, into the future, so that the element of uncertainty could be eliminated from the problem, then the problem would become a question of pure engineering economics, which could be solved by arithmetic if the course of future prices in energy, copper and other essential commodities were also included in the benevolent spiritualistic forecast. In present practice, of course, the elements of uncertainty cannot be eliminated, and the problem includes both engineering economics and a commercial estimate based on experience. This means that the curves of loads and prices, as plotted against time, may not safely be extended by guesswork more than a certain number of months ahead, and the problem of engineering economics becomes restated within these limitations.

The article by Mr. A. W. Welch which we print this week discusses this question for the case of a low-tension, three-wire conducting system in a city. The main problem is how much capital will be invested idly, for the monent, in reinforcing a feeder, and how long will the saving in power, through reduced I^2R loss, take to pay off the investment, assuming that the load never rises above what is in sight, say, twelve months ahead? The question is a many-sided one, involving Kelvin's economy law as one of its aspects, but also involving such matters as obtaining city permits to open street trenches, prospective changes in prices, voltage-regulation facility, etc. One very important detail to be settled before the question of economics can be decided is the unit cost of energy wasted in the feeder. The article offers the choice between 2 cents and 1 cent per kw-hour, favoring the former, and does so in the right direction, according to our view. The question here at issue is vital and yet is very differently answered among different central-station men. Some of the men will maintain that a kilowatt-hour is a unit of energy that has to be supplied at the switchboard, whether it is wasted just beyond the switchboard itself or a mile away. They contend that on a hydraulic system if a cubic foot of water at the delivery valve of the pump costs a certain fraction of a cent, then if leakage occurs in the distributing pipes the pumps have merely to furnish extra cubic feet in order to replace the loss, and that the unit cost of this should be the cost of a cubic foot at the pump. Others will maintain, however, that in the hydraulic analogy if the leakage is distributed over a wide area of pipes the unit cost of replacement is properly the cost of delivering a cubic foot of water at the mean distance of leakage, and that wasting a cubic foot at a mile from the pump costs the supply company more than wasting a cubic foot at the pump. A good debate on the above question should be interesting to attend. It seems to us, however, that there is force in the arguments in favor of reckoning the company's cost of replacement at the mean position where the waste occurs. If the company, instead of supplying energy to consumers, supplied it to itself without profit and at bare cost of production, the unit cost of energy wasted would be, not the unit cost at the switchboard, but the unit cost at the average delivery distance, thus including distributing-system costs.

RELATIVE EFFICIENCY OF VARIOUS EARTHS IN RADIOTELEGRAPHY.

The article by Prof Charles A. Culver, on page 1360, is a good illustration of the advantage that may be derived from making a series of simple systematic experiments and stating the results obtained without encumbrances of deduction or theory. In the case described an inclined sending antenna was used in conjunction with a vertical receiving air-wire, and also with a horizontal receiving air-wire. The inclination of the sending antenna in the direction of the receiving station introduces an element of complexity into an otherwise relatively simple system; nevertheless, the results obtained suggest some interesting explanations. It is well-established doctrine that the ground made in wireless telegraphy should be thoroughly good at both sending and receiving stations in order to realize the best results obtainable from a given power radiated. At the sending station the waves virtually start from a conducting base, which, if not physically provided at the surface of the ground, provides itself at a lower moist-earth level, at the sacrifice of the radiation energy that is thus entrained into the substance of the soil. Similarly, at the receiving station, if a good conducting base is not provided at the foot of the air-wire, the receiving antenna provides its own conducting base at permanent moisture level and uses the overlying stratum of soil as a leaky condenser up to the foot of the mast wire, with a corresponding sacrifice of energy in the receiver. The results reported in the article seem to be consistent with our existing theories of wave transmission and reception, imperfect as these admittedly are. It is interesting to note that a horizontal antenna, wheeled about in various directions close to the ground, should so easily give results comparable to those obtained with much greater effort on larger and less portable receiving mast wires. The plan is in conformity with that which has to be used within laboratories when investigating the behavior of radiating systems. Small model radiators and receivers are used in such a manner that a short wave-length is produced, and that the two stations, although physically close together, are electrically separated by a number of wave-lengths. Although the arithmetic of freely radiated waves is advancing, we shall have to depend for the present on an abundance of such experiments.

Street-Lighting Tables.

With the present issue there is given, in the form of a supplement, our annual street-lighting schedules prepared in conformity with a plan followed continuously since 1890, when the schedule devised by Mr. W. H. Frund was first published.

According to the table designated as No. 1 the lamps are lighted one-half hour after sunset and are extinguished one hour before sunrise. By such a plan the lamps are in service for about 3830 hours per year. An "all-night" lighting schedule giving a total of about 4000 hours could be obtained by lighting fifteen minutes earlier and extinguishing fifteen minutes later than shown.

Table No. 2 is the so-called "Philadelphia Moonlight Schedule." This schedule differs from that of Table 1 in that advantage is taken of moonlight, beginning with the fourth night after new moon. On moonlight nights the lamps are extinguished one hour after moonrise and lighted one hour before moonset, with the exception of the night before, the night of and the night after full moon, when the lamps are not lighted. This schedule involves the use of the lamps for about 2000 hours per year.

Table No. 3 is calculated according to the compromise system of Mr. Frund, and ignores the moon until midnight throughout the year. After midnight the lighting hours are the same as in Table No. 1 except that the lamps are not used on the three nights before full moon. According to this schedule the lamps are used for about 3000 hours per year.

All of the tables are based on mean local time and may be considered correct within ten minutes for any place in New York, Connecticut, Pennsylvania, Rhode Island, New Jersey, Ohio, Indiana, Illinois, Iowa, Delaware, Maryland, Virginia, West Virginia, Kentucky, Missouri, Kansas, Nebraska, Utah, Colorado, Nevada and northern California. They are also correct within ten minutes for all places within the United States proper during the months of March, April, September and October. The maximum disagreements are reached in June, when the nights are shorter in the Northern than in the Southern States, and in December, when the reverse is the case. During these months the disagreement along the northern border of the United States and as far south as Charleston, Birmingham and Los Angeles will not exceed twenty minutes. A maximum disagreement of one-half hour may be assumed for Jacksonville, Fla., and Houston, Tex.

Recommendation of Award of Edison Medal to George Westinghouse.

A meeting of the Edison medal committee of the American Institute of Electrical Engineers was held in New York on Nov. 24 to make a recommendation for the award of the Edison medal in 1912. In opening the proceedings Prof. Elihu Thomson, chairman of the committee, explained that the meeting was called in accordance with the by-laws to discuss the names that had previously been suggested by ballot of the committee as meriting an award of the medal, and to select one name to be submitted formally to the members of the committee for selection or rejection in December.

A general discussion, lasting for three-quarters of an hour, followed the raising of the question as to the nature of the "achievement" contemplated in the by-laws. There seemed to be some difference of opinion of the scope to be allowed in interpreting the word, especially as to whether it should include achievement of an administrative character in connection with the electrical industries on the one hand, or on the other hand should be confined to achievements relating to the electrical science and arts. After considerable discussion it seemed to be the consensus of opinion that administrative achievement came within the scope intended if it involved engineering foresight or judgment of possibilities, and more especially if it took the form of conceiving a possible combination of a number of scientific elements which together might constitute creation of a new industry. It seemed to be also the consensus of opinion that administrative achievement confined to business methods and ordinary promotion from small to large magnitude was not contemplated.

After complete discussion, in which practically all members took part, Mr. George Westinghouse was nominated by Mr. Frank J. Sprague as candidate for the Edison medal "for meritorious achievement in connection with the development of the alternating-current system for light and power," and upon vote the motion was carried. The name of Mr. Westinghouse will be submitted to the members of the committee for mail voting by secret ballot, in accordance with the by-laws, the result of which will be announced in December.

A. I. E. E. Meeting and Smoker.

Following the business portion of a meeting on Dec. 8 of the American Institute of Electrical Engineers, at which a paper on "Methods of Varying the Speeds of Alternating-Current Motors" will be read by Mr. Gus A. Maier, an informal reunion and smoker will be held in the Engineering Societies Building, New York. The reading of the paper will be started promptly at 8:15 p. m. At 10 o'clock the tenth floor will be thrown open and the members will go from the auditorium to meet each other in the Institute rooms. Should any prefer to continue the discussion in the auditorium it will be arranged that they may do so. Light refreshments will be served.

The American Institute of Electrical Engineers and Water-Power Development.

The difficult and unsatisfactory situation existing at present in regard to the development of water-powers of the United States some time ago led the United States National Waterways Commission to provide for a public hearing for the discussion of water-power questions in Washington on Nov. 21. The American Institute of Electrical Engineers was invited to attend and to contribute to this discussion, as were also a number of other societies and certain individuals prominent in the field of water-power development. The board of directors regarded the acceptance of this invitation as a duty to the membership of the Institute, in view of the provisions of the constitution and in view of the public nature of the question. On Nov. 10, on recommendation of the public policy committee, it passed a resolution authorizing the public policy committee to attend the hearing and to express its views on the development of water-powers, such views to be kept as far as possible within the limits of engineering questions and presented as a written brief, together with such discussion of this brief at Washington as may be necessary to make clear the views contained. It was further provided that the president be authorized to request the co-operation with the public policy committee of such members of the Institute as are experts on water-power development and who the committee feels would help its deliberations and its standing at the hearing at Washington.

The president appointed as the advisory members called for in the resolutions Messrs. Edward D. Adams, Philip P. Barton, Louis Bell, Dugald C. Jackson, William S. Lee, Lewis B. Stillwell and Percy H. Thomas.

The public policy committee appointed a sub-committee consisting of President Dunn and Mr. H. W. Buck to make a preliminary draft expressing its views, which draft was submitted to a full meeting of the public policy committee and the advisory members, and was modified to conform to and to represent their joint opinion. On Nov. 20 the president of the Institute, Mr. Stott, chairman of the public policy committee, and Messrs. Townley, Stillwell and Finney went to Washington to represent the Institute at the hearing which, on Nov. 21 and the morning of Nov. 22, was devoted by the commission to the presentation of the Institute's views and such discussion of them as was brought out by questions of the commissioners.

President Dunn defined the attitude of the American Institute of Electrical Engineers toward the issues by pointing out to the commission that the Institute was a scientific and professional body and not commercial, and that it refrained from making suggestions or expressing its views on the commercial, political, legal or other aspects of the water-power situation except as these were incidental to the questions of electrical engineering involved which it brought to the attention of the commission. He also discussed under cross-examination by the commission the factors determining the rates for water-power, the statistics on developed and undeveloped water-powers in the United States, and the engineering as distinguished from the commercial advantages of interconnection of contiguous hydroelectric systems.

Mr. L. B. Stillwell answered questions of the commission in regard to distances over which electric transmission was possible, the causes of interruptions to service in hydroelectric systems as compared to the same interruptions in steam-electric systems, and the difficulties in securing capital on account of the large investment required by hydroelectric systems. He also pointed out that the value of a stream as a source of power was usually much greater than its value as a waterway.

Mr. Calvert Townley presented to the commission views in regard to the difficulties under which hydroelectric systems labored in their early stages from failure of their expected market to develop, and answered many questions of the commission regarding the development of water-powers in New England and the bearing of steam auxiliaries upon the income of hydroelectric systems.

Mr. Stott on the second day of the hearing gave information on the rate at which the cost of coal had been rising in the last decade and the rate at which coal consumed per hp-hour in steam stations had been falling. He was questioned by the commission in regard to the control steam competition exercised over the rates of hydroelectric companies and on the first cost of steam-electric stations.

Mr. Finney described the interconnections of the plants of the Southern Power Company and the advantages, not only engineering but otherwise, that resulted therefrom, and gave important information to the commission upon the opportunities for the utilization of secondary power of hydroelectric systems for electrochemical purposes. Mr. Finney also answered many questions of the commission in regard to the general relations of the water-power companies of the South.

Mr. Edward D. Adams, as one of those specially invited by the commission, submitted views to the commission in writing upon the economic features of the question.

The Institute delegation left after the morning hearing on Nov. 22. The rest of the hearing was devoted to other societies and to members of the National Electric Light Association. An abstract of the brief required by the board of directors follows:

A. I. E. E. BRIEF.

In opening, the brief states that the function of the American Institute of Electrical Engineers is scientific and professional, and is not commercial; consequently, its committee refrains from expressing itself on the commercial, industrial, legal or political aspects of the water-power situation, except when these are incidental to the effect of that situation upon the practice of electrical engineering, which it is the society's object to promote. It is also appreciated that the commission is probably desirous not of the views of particular individuals, which might represent only individual opinions, but would be glad to have before it such opinions as are shared by a group of experts and may therefore be regarded as representative and out of the field of controversy.

Attention was called to the fact that prominent electrical engineers have for a number of years been contributing to the *Transactions* of the American Institute of Electrical Engineers papers bearing on all phases of the water-power question, and that the subject is one of vital interest to the American Institute of Electrical Engineers because the whole character of water-power development has been changed from that of a local enterprise to that of a great public-service utility by means which electrical engineers have provided, and the utility and development of water-power depends almost entirely upon the fact that it may be transformed into electric power.

RELATION OF WATER-POWER TO NAVIGATION.

That the utilization of rivers and smaller streams for navigation and for the development of power are naturally inter-related is obvious. As regards by far the greater part of undeveloped water-powers on the public domain, the ultimate value as sources of power of those streams is vastly greater than any possible value which could be realized by attempts to utilize them as channels for navigation, though in the case of many of our larger rivers the possibilities of development for purposes of navigation predominate as compared with power development. In all cases where practical possibilities of both navigation and power development exist the two objects in view are co-operative and not antagonistic—the construction of the dams and locks necessary to secure navigability affording a natural and generally effective means of developing the power of the streams.

WATER-POWER A PUBLIC UTILITY.

Modern water-power developments usually are not local private enterprises, as is generally supposed. The developments in recent years in the electrical transmission of power have made possible the distribution of electric power from a single water-power plant over territories embracing in some cases over 40,000 sq. miles in area, supplying electric power for diversified purposes to hundreds of thousands of people. Such distribution of water-power is an advantage to the consumers, and any policy tending to retard or handicap the development of water-powers is a disadvantage to the people in the surrounding territory and retards its industrial development.

The regulation of public utilities by public-service commissions has become practically an accepted principle in the United States, and there is no reason why safeguard from unfair charges for water-power should not be found by this means, especially where the wide area covered by electrical distribution makes the public nature of a water-power obvious.

DISTRIBUTION OF INVESTMENT IN HYDROELECTRIC SYSTEMS.

The investment of capital in hydroelectric systems is not confined to the dam and power house. In general, not over 50 per cent of the investment is represented in the generating plant, the balance representing the cost of the transmission lines radiating from the plant, the substations at the ends of the transmission lines for the conversion and distribution of the transmitted power, and the secondary distribution lines delivering power from the substations to the premises of the various consumers. The distribution system outside of the power plant, while not apparent to the casual observer of a power house and dam, represents

in many hydroelectric developments the greater part of the total investment.

COMPETITION BETWEEN WATER-POWER AND STEAM-POWER.

The belief among certain classes of the public that water-powers yield excessive or disproportionate profits springs primarily from two causes—the conception that the water itself is the power and the idea that the expenses of operation of a water-power are small while the company's income is large.

While, certainly, the power could not be devoloped without the water, the water on its part can deliver no power except by means of the dam, the power house and its appurtenances. It is difficult for the public to regard these once built as involving continuing expense, but they do. This expense is comparable in amount with the cost of coal in a steam station, and is the return due to the capital invested. It takes the form of interest, sinking-fund expenditures, depreciation and taxes. The invested capital in a water-power is much greater than the public realizes; with interest charges at not more than 5 or 6 per cent, in a majority of cases, from 70 to 80 per cent of a water-power-company's income is absorbed. This return to capital is not profit. Without the prospect of it capital cannot be secured.

Of a water-power once built and after its expected market has been developed the operating expenses, exclusive of the returns to capital, are seen by the public to be small, which they are, in a majority of cases absorbing only from 15 to 20 per cent of a company's income. The remainder, however, that is left for profit after capital and operating charges are paid is usually not large and certainly not excessive, especially when there is always risk of damage from floods, lightning, failure of expected market to develop, and such uncertainties of operation as the art of electrical engineering has not yet been able completely to remove. Practically all water-power development depends on the answer to the question "What is steam-power in the territory costing?" and the sources of water-power can be utilized only when they deliver energy at a substantially lower cost.

Besides the cost of power, the relative amount of investment is a determining factor. While at present a steam-electric plant can be built for $75 per horse-power, the cost of a hydroelectric plant is from two to four times that amount. Part of this difference is because the steam plant can be built near the center of its market, while the water-power is almost invariably at a distance.

With the capital required for a water-power so much greater, the tendency is to build a steam plant, even if the power it delivers is not as cheap as that of a water-power. If it can be shown that water-power can be delivered for, say, $25 per horse-power per year, but that steam-power can be produced for, say, $27, the water-power plant will not be built, but a steam-power installed. If, however, the water-power could be delivered for $24, the difference might turn the tide in favor of the hydroelectric investment.

It is because of the great effect of slight differences in the cost of water-power upon the determination of the question "Shall water-power or steam-power be developed in a given community?" that even light burdens in the form of taxation, charges for sinking fund to wipe out the investment at the end of a limited period or limitations as to tenure, even though not immediately onerous, loom so large in settling it.

Attention is often called to the increasing cost of coal, with an implication that the cost of steam-power will rise, permitting hydroelectric companies to raise their rates and exact undue profits. The implication is not correct. It is true that the cost of coal is rising, but it is also true that steam engines and boilers are constantly being improved in efficiency, and that the art of producing power from steam is progressing at a rate so much more rapid than that at which the price of coal is rising that the cost of steam-power is continually falling. Should a limit to this fall be reached, which is not yet in sight, gas and oil engines are making such constant reductions in the cost of power that there is no probability that water-powers will be free from the controlling competition of other kinds of prime movers. It is safe to say that extortionate rates in water-power would be highly improbable, even if the principle of rate regulation by commission were not applicable to hydroelectric companies.

CONSTRUCTION RISK IN HYDROELECTRIC DEVELOPMENT.

While hydroelectric engineering is tending toward more standard methods of construction, each individual development will present new problems in engineering, with the inevitable construction risk connected therewith. During construction the works are constantly subject to serious damage by abnormal floods, and unexpected difficulties and physical conditions may arise whereby the cost of construction may be very materially increased beyond original expectations. Furthermore, after the plant itself is satisfactorily completed, the success of the enterprise is commonly dependent upon the industrial development of a large territory surrounding the plant upon which it relies for its market for energy. Such industrial growth can be predicted only on general principles, and may be subject to unexpected retardation due to industrial depression or other unforeseen causes. Again, unexpected competition may develop from new and improved steam and other engines, all of which limit or defer the profits of the enterprise. On account of these engineering and operating risks and uncertainties capital which is invested in hydroelectric enterprises is entitled to reward commensurate with the risk.

REVOCABLE OR LIMITED-TERM PERMIT.

The revocable permit for the construction of a hydroelectric system does not attract capital because of the obvious uncertainties involved. In case of revocation, not only would the power plant and dam be forfeited, but all of the transmission lines, substations and distribution system dependent thereon for their operation would be jeopardized. Not only is it difficult to induce capital to invest in such a development based upon a revocable permit, but it is very difficult to close the long-term contracts with consumers which are necessary to make a hydroelectric system financially successful. Consumers are unwilling to make their future business requiring power dependent upon a permit which might cause at any time the complete disorganization of the system supplying it.

A limited-term franchise also involves financial and engineering difficulties which seriously impede the normal development of a progressive hydroelectric system. Such systems are laid out from their inception for ultimate growth, and in this respect are comparable to large railway systems. The transmission lines are constantly reaching out into new territory in order to meet new demands and with the development of the art it is necessary to make investments in extensions in order to maintain satisfactory service and to meet the demands of consumers.

With a limited definite term beyond which renewal of rights is uncertain, no company would be willing to continue indefinitely the extension and improvement of a system so necessary and desirable from the standpoint of public service. The necessity of writing off not only the original cost of the plant but the continual annual investment in additions thereto within the limited term of the permit requires an annual sinking fund that adds materially to the cost of the water-power. This is a hardship, not only upon the company, but upon the consumer.

Before the end of such limited-permit development of the system would cease, maintenance expenses would be cut to a minimum, and the plant would deteriorate to a

point where the service to the public would become unsatisfactory.

INTERCONNECTION OF CONTIGUOUS HYDROELECTRIC SYSTEMS.

It has been suggested that with the growth in extent of large hydroelectric distributing systems ultimate interconnections and combinations between them might establish a monopoly and permit the raising of prices for energy. Such interconnection between contiguous hydroelectric systems offers decided and important engineering advantages. It improves the constancy of electrical pressure and enables the system to draw power from two or more independent power plants.

The rainfall occurring at different times on two or more separate watersheds is thus made to benefit all of the consumers on the combined systems. Such interconnection also permits reduction in operating expenses and assures better service by reducing to a minimum the probability of total interruptions at any time from line troubles or otherwise.

The investment and consequently the cost of energy can be reduced by combination, because less capacity in generating machinery to serve as spare plant for emergencies need be installed, and operating expenses can be reduced by rendering repairs easier, owing to greater facilities for shutting down for work or for inspection. Any tendency toward raising the price of energy as an accompaniment of such combination is restrained automatically by competition with steam-power, and can be regulated by government commission.

EXTENT OF WATER-POWER DEVELOPMENT.

The statistics of water-power collected under the direction of Congress several years ago and embodied in the report of the National Conservation Commission of 1909 show that there is at present developed in the United States about 5,000,000 hp of water-power.

The amount of power produced by steam from coal is difficult to estimate, but is considered to be about 27,000,000 hp, and is rapidly increasing, with attendant depletion of coal reserves. A large part of this it is not only possible but easy for water-power to replace if it were made freely available through development. Within range of development at a cost of investment that would make the cost of such power about equal to that of steam-power, there is still undeveloped in the streams of the United States about 35,000,000 hp.

Any action by Congress that would accelerate the release of this power would conserve enormous supplies of coal for such domestic and industrial purposes as only coal can supply.

CONCLUSION.

The brief repeats that it is beyond the province of the Institute to urge upon the commission specific measures or to discuss other than incidentally phases of the water-power question not involving electrical engineering. It has therefore offered what appear to that body to be engineering and economic facts on which the commission may rely.

Magnification of Electric Currents.

At a meeting of the National Academy of Sciences held in New York on Nov. 22 Prof. M. I. Pupin gave a preliminary account of a theoretical and experimental investigation of the problem of magnifying the feeble electric currents used in cable telegraphy and telephony. As a result of experimental work conducted during the past five years Professor Pupin has developed and built an induction-type generator by means of which feeble currents in a circuit can be magnified to any desired extent, the generator acting locally somewhat as an energy relay. The feeble current is passed through the primary circuit of the generator, the secondary of which consists of a small disk of copper driven by external power. On account of the self-excitation of the machine and the reaction between the primary and secondary currents, the current in the primary is enormously augmented. In the early experiments considerable difficulty was encountered by reason of an inherent tendency of the machine to become excited automatically to an excessive degree. In a machine recently completed these difficulties have been overcome, and the theory of its operation, which was worked out by Professor Pupin some years ago, has been thoroughly verified. Professor Pupin has announced his intention of describing both the theory and the machine in detail in a paper to be presented before the American Institute of Electrical Engineers.

On account of the many novel features of the work mentioned by Professor Pupin in his brief outline before the National Academy of Sciences, the New York daily papers contained numerous incorrect statements as to the significance of this work, in one case the claim being made that by the use of the Pupin invention street cars could be operated from telephone circuits.

Proposed Extension of Municipal Electric Pumping in Chicago.

In a communication dated Nov. 16, 1911, Mr. John Ericson, city engineer of Chicago, laid before Mr. L. E. McGann, the commissioner of public works, an elaborate report on the condition and needs of the water supply of the city. Mr. McGann transmitted the report to the City Council, which referred it to the committee on water department. Mr. Ericson's report contained some interesting references to the proposed electrical operation of waterworks pumping stations.

In the Lake View (North Side) pumping station it is recommended that two electric-motor-driven centrifugal pumps, each of about 25,000,000 gal. rating per twenty-four hours, be installed for temporary relief and ready for operation by June 1, 1912. The estimated cost, including piping, valves, switchboard and wiring, is $85,000.

At the Twenty-second Street (West Side) station it is planned to construct an entirely new pumping station. Such station, when complete, will then contain the two 25,000,000-gal. electric motor-driven centrifugal pumps which are now being completed in the present Twenty-second Street station. Two additional pumping units of similar size and type are to be ordered as soon as possible. The two pumping units of similar type recommended for temporary use at the Lake View station, as mentioned above, are also recommended to be placed in this station. This new station when completed will then be entirely modern and contain six 25,000,000-gal. electric-motor-driven centrifugal pumps, with a normal combined rating, against a head of 130 ft., of 120,000,000 gal., and a maximum rating against a slightly lower head of 150,000,000 gal. per twenty-four hours. It will be an entirely electrical station, thus avoiding all complications attendant on the use of both steam and electric drive. In case of temporary failure of the electric power, to be obtained from the Chicago Drainage Canal, the district normally served from this station can be supplied by reserve engines to be provided elsewhere. This new electrically operated station will require less ground area than the present one. The two new electric pumps for this station are estimated to cost $60,000.

For the present Rogers Park (North Side) pumping station it is advised that automatically controlled, electrically driven centrifugal pumps, receiving energy from the Sanitary District, be installed for connection with the sewer system in this district. These motors can be placed in small, well-protected masonry chambers so as to be prop-

erly protected against moisture and freezing. On the completion of such an installation, or an equivalent one, the Rogers Park pumping station can be entirely abandoned by the city as far as operating the plant is concerned.

It is recommended that a new booster pumping station be built in the neighborhood of Forty-eighth Avenue and Milwaukee Avenue (Northwest Side). The booster station, it is advised, should contain two 1,000,000-gal. motor-driven centrifugal pumps, complete with auxiliaries, appurtenances and accessories. The estimated cost of this booster station, including property, building and foundations, completely installed and ready for operation, is $9,000. The cost of transmission lines and connections to station is $3,000.

Plan for Electrification of All Boston Transportation Service.

The regular monthly meeting of the New England Section of the Electric Vehicle Association of America was held at the Lowell Building, Massachusetts Institute of Technology, Boston, on the evening of Nov. 23. Mr. E. S. Mansfield, president of the section, was in the chair, and the speaker was Mr. Henry C. Long, of Boston, author of the Boston harbor and dock improvement bill passed at the last legislative session. Mr. Long outlined, with the aid of eighty lantern slides, a plan for the abolition of all steam and horse traction within the Boston district and the substitution of electric power for handling every form of transportation of passengers, merchandise and freight.

The plan includes the construction of a 52-mile, four-track suburban belt railroad around the outer edge of the Boston metropolitan district from Lynn to Hull; the provision of electrified passenger and freight service on the belt line; electrification of all steam-railroad lines within the metropolitan area; construction of an electric freight elevated inter-warehouse and wharf railroad, and complete electrically operated shipping and receiving docks and wharves along the Boston waterfront, with provision for the handling of freight off the railroad tracks of the district by electrically driven tractors and storage-battery trucks. An important feature of the plan is the reservation of an industrial right-of-way for factory location along the belt line, with provision for electrical operation of all industrial plants thus situated.

Mr. Long stated that at the forthcoming session of the Legislature a bill will be introduced on behalf of the scheme, which is designed in many respects to make use of the best points of the systems now in service in Liverpool, Odessa, Melbourne, St. Louis and other cities. The speaker contended that the removal of horse traction from the streets would pay for the belt-line system, and argued that terminal costs at Boston could be greatly reduced by the adoption of electricity along the lines indicated.

Tubular Tungsten-Lamp Filament.

A patent issued on Nov. 14 to Dr. W. D. Coolidge, of Schenectady, N. Y., on an application filed Aug. 1, 1906, covers tubular filaments of incandescent lamps so arranged as to have a relatively large radiating surface per unit volume. The shape selected enables one to use less filament material when building a lamp of a certain candle-power for a definite voltage.

Incidentally the patent discloses a method of obtaining ductile tungsten wires. The material for the filament is obtained in the form of a fine powder by the reduction of tungsten trioxide with hydrogen or with finely divided carbon or graphite. The powder thus obtained is relatively non-coherent, and in general cannot be worked into lamp filaments without the application of some special treatment or process for shaping the refractory powder into coherent wires. According to one process, the refractory tungsten powder is rubbed into a warm plastic amalgam consisting of equal parts of cadmium and mercury, the tungsten being added in the proportion of 40 per cent or more by weight. The product thus obtained may be squirted warm through a die or may be otherwise manipulated. After obtaining ductile wires as above described, they are rolled out into strips having a relatively large surface area. These flat strips are drawn through a steel, sapphire or diamond die of the proper size to curl them up into tubes. The edges of the strip may be overlapped to strengthen the finished filament, or a gap or slit may be left between the opposing edges of the tube.

To remove the volatile components above mentioned suitable lengths of the strip or tube are mounted in treating bulbs and there subjected in vacuo or an inert atmosphere to the heating action of current passed therethrough. The current distils or vaporizes the cadmium and mercury of the binding material and consolidates and sinters together the particles of tungsten. The relatively large surface of the flattened wire or tube brings a large proportion of the filament within a very short distance of either the front or back surface of the strip, so that when the strip is heated by current volatile material can pass out without difficulty and without disturbing the arrangement of the refractory particles of the conductor. The finished filaments may be straight or looped and are operative on higher voltages than could be used with the same material disposed in a cylindrical wire.

Milwaukee's Electrical Industry.

A preliminary statement of the general results of the thirteenth United States census relative to the manufacture of electrical machinery, apparatus and supplies in the city of Milwaukee, Wis., has been issued by the Bureau of the Census. The accompanying summary comparing the figures for 1904 and 1909 shows percentages of increase for all items except for capital invested and for miscellaneous expenses, which exhibit decreases.

There was an increase of 50 per cent in the number of establishments; 22 per cent in the value of products; 52 per cent in the number of salaried employees; 20 per cent in the salaries; 22 per cent in the average number of wage-earners employed during the year, and 22 per cent in the wage-earners' wages.

STATISTICS OF MILWAUKEE'S ELECTRICAL INDUSTRIES.

	CENSUS.		Per Cent of Increase 1904 to 1909.
	1909.	1904.	
Number of establishments	18	12	50
Capital	$3,656,000	$5,133,000	*29
Salaried employees	$340	$223	52
Salaries	$372,000	$310,000	20
Wage-earners (average number)	998	815	22
Wages	$598,000	$491,000	22
Miscellaneous expenses	$352,000	$543,000	*35
Cost of materials used	$928,000	$655,000	42
Value of products	$2,749,000	$2,257,000	22

*Decrease.

There were eighteen establishments in 1909, as compared with twelve in 1904, an increase of six. The value of products in 1909 was $2,749,000, as compared with $2,257,000 in 1904, an increase of $492,000.

The value of products represents their selling value or price at the plants as actually turned out by the factories during the census year and does not necessarily have any relation to the amount of sales for that year. The values under this head also include the amount received for work done on materials furnished by others.

Meeting of the Empire State Gas & Electric Association.

A meeting of the Empire State Gas & Electric Association was held on Nov. 22 at the Technology Club, Syracuse, N. Y. The meeting was one of the series of gatherings which are now held by this association each year at different points in the State. The general subject under consideration was street lighting, and between fifty and sixty representatives of companies from different parts of the State were present.

Mr. H. W. Peck, of Rochester, chairman of the committee on arrangements for the meeting, presided. The subject under discussion was introduced by Mr. M. G. Kennedy, of Syracuse, who referred to the importance of the topic and said that lantern slides illustrating the lighting in Syracuse would be presented later. Mr. H. Thurston Owens, New York, exhibited slides showing lighting effects in foreign cities and explained methods in use. Others also exhibited lantern slides.

During the discussion the talk turned upon two or three special points to which much consideration was given. One was the question of the cost of furnishing service of this character. The elements entering into the question of cost were studied carefully, and an analysis was made to show the proportion of the total represented by each element of expenditure or charge that should be made against this service. Other subjects which were brought up and discussed at length were the use of tungsten lamps on magnetite arc circuits, the life of rectifier tubes, the advantages and disadvantages of tungsten lamps as compared with arc lamps and the relative advantage or disadvantage of ornamental lighting as compared with illumination.

Among the speakers were Messrs. A. D. Dudley, Syracuse; W. T. Dempsey, New York; John P. Radcliffe, Jr., Yonkers; J. O. Montignani, Rochester; L. C. Reynolds, Auburn; G. T. Macbeth, Mount Vernon; De A. Ryan, General Electric Company; Mr. Place, Westinghouse Electric & Manufacturing Company; Norman Macbeth, Westinghouse Lamp Company, and G. S. Barrows, United Gas & Improvement Company.

The delegates had lunch at the Hotel Onondaga, Syracuse.

Railway Telegraph Superintendents at Chicago.

A two-day joint meeting of the Eastern and Western divisions of the Association of Railway Telegraph Superintendents was held in Chicago on Nov. 23 and 24. Mr. C. Selden, of the Baltimore & Ohio, Baltimore, chairman of the Eastern division, presided on the first day, and Mr. E. A. Chenery, of the Missouri Pacific, St. Louis, on the second. The first day's session was given over largely to traffic considerations and the filing of message forms. A recent ruling of the Interstate Commerce Commission has required the commercial telegraph companies to file message sheets and classify accounts in accordance with the commission's recommendations, and these orders, it was believed, might affect railroad telegraph business as well.

On Friday the subject of train dispatching by telephone versus telegraph came up for discussion. Mr. G. A. Cellar, of the Pennsylvania Lines West, who is also president of the telegraph superintendents' association, declared that where telephone dispatching has shown a saving in number of dispatchers and in operators' salaries such economy has been distinctly offset by the increased cost of operation and maintenance of the telephone lines. Mr. W. C. Walstrum, of the Norfolk & Western Railroad, reported the cost of operating his telephone system to be $1.01 per mile of road per year. Special maintainers and linemen are employed.

Mr. C. S. Rhoads, of the Big Four Railroad, Indianapolis, said his 1400 miles of telephone lines have been in service nearly three years, resulting in a substantial decrease in dispatchers, salaries and offices, compared with telegraph operation. Besides saving labor, he declared telephone operation to be much safer, since the sending operator is required to write down the orders as he transmits them, assuring a speed at which the receiving station can follow. In telegraph practice it had become customary to "send" much faster than the matter could be written down at the receiving end, the operator catching down only occasional words and depending on his memory to fill in the gaps later. This produced many errors in train numbers, meeting times, etc., declared Mr. Rhoads. The speaker also noted the possibility of simplexing telephone dispatching lines for through Morse operation, gaining a number of additional telegraph circuits. By inter-operation with friendly roads it is thus possible to establish circuits which may become useful in establishing communication around fallen line sections, accidents to poles, etc. Mr. Rhoads said his 1400 miles of lines are taken care of by three inspectors, who receive $65 a month, with unlimited expense accounts, and have the aid of twenty-one linemen. Twenty-one motor cars are in use by these men.

Mr. W. F. Williams, of the Seaboard Air Line, asserted that the saving effected by telephone operation cannot be expressed on a monetary basis. The figures for his own 1100 miles of lines, he said, show a gain of 11 per cent in train time, in spite of an increase of 14 per cent in track density. Mr. J. J. Ross, of the Michigan Central Railroad, declared that the presence of simplexing apparatus on his telephone circuits seemed to clear the lines by discharging static accumulations. Mr. F. H. Van Etten, of the Chicago, Terre Haute & Southern, also recounted his experience.

On Thusday the association was the guest of its associate members at luncheon, visiting the factory of the Kellogg Switchboard & Supply Company in the afternoon. On Friday afternoon a special car was provided to convey the members to the Hawthorne plant of the Western Electric Company, where a luncheon was served preceding an inspection of the works.

Co-operation Among Electrical Contractors.

At a joint meeting of the Chicago Electrical Contractors' Association and the Faraday Electrical Association (the latter an organization of the smaller electrical contractors in Chicago) held recently Mr. Frederic P. Vose, secretary and counsel of the Electric Credit Association, of Chicago, gave some good advice to the contractors in an address bearing the title "Need of Organization." He asked the question, "What's the matter with the contracting business, anyway?" He said that the greatest losses of the electrical manufacturers and jobbers occur in the extension of credit to electrical contractors. This would seem to indicate that a large number of these contractors have not yet learned to do business on business principles. This state of things proves the need of organization.

The manufacturers and jobbers are coming to regard it as better policy to push their sales to responsible contractors rather than to discourage them by furnishing their irresponsible competitors with the means with which to cut into the business. However, all commercial virtue is not monopolized by the big contractor. There is many a small contractor who possesses integrity, ability and energy and who should be encouraged. Mr. Vose said that there are three things to be observed by the small contractor: First, to sell product and service at a proper margin above cost; second, to adopt business methods that are really methodical; third, to practise and maintain honest principles, not only toward customers but also toward competitors.

In determining a proper margin of profit there must be taken into consideration operating expenses, current ex-

penses, selling expenses, rent, salaries, wages, superintendence, interest, insurance (fire, accident and industrial liability), light, heat, power, postage, stationery, taxes, telegraph and telephone, bad debts and allowances, freight, cartage, express, carfare, advertising, breakages, counterclaims, damage claims, loss of time through manifold causes, lean years due to business depression, and many other items. Furthermore, it is to be remembered that 50 per cent added to the cost is only 33⅓ per cent on the selling price. It is better to figure percentages of profit on the selling price rather than the cost price, because in the latter case business men are apt to become prodigal of expense.

Recounting the advantages of association, Mr. Vose mentioned the interesting fact that the business done annually by the members of the National Association of Electrical Contractors exceeds $32,000,000. It has been discovered that the expense of carrying on an electrical contracting business under favorable conditions will be not less than 17.5 per cent of the total business done and may run up to 28 per cent as the amount of business decreases. The practice of relying on "extras" for a profit was denounced strongly. Three "C's" are necessary in the triangle of business success. These are character, capacity and capital.

Proposed Order for Stenciling and Numbering of Poles in New York.

The tentative form of a proposed order requiring companies to stencil and number their poles and structures for carrying overhead wires has been prepared by the New York Public Service Commission, Second District. The order is to apply to all electrical, municipal, telephone, telegraph, railroad and street railway corporations.

A formal hearing upon the form of the order was held by the commission at Albany on Nov. 23. Objections to the order were made by representatives of steam and electric railways and telephone and telegraph companies. Mr. C. G. M. Thomas, Long Island City, vice-president of the Empire State Gas & Electric Association, presented on behalf of the association a suggestion for amendment of the form of the order.

As proposed tentatively by the commission, the order requires that each pole of the corporations of the classes named be stenciled with a number and the initials of the company. Certain details as to the height of the mark, etc., were included in the order. It was also provided that the poles should be numbered consecutively, beginning at the station. It was stated on behalf of the companies in the Empire State Association that it would not be practicable to number the poles consecutively from the station. In case two lines should extend from the station it would not be possible to mark them except in different ways. In the case of extensions of pole lines it might be desired to add lines branching from the main line, and in this case it would not be practicable to number the poles consecutively.

It was suggested, therefore, on behalf of the companies in the association, that the order omit all details as to size and height of lettering on poles, and that it specify merely that each pole be marked in some way that would indicate the ownership clearly. It was also suggested that the lettering be readable, under ordinary circumstances, at a distance of 6 ft.

Concerning the identification of poles, it was recommended that each company report by Feb. 1, 1912, the method of marking poles which is in use on its system at the present time. This information, when furnished to the commission, should show the manner both of marking poles and of numbering them for identification. If companies have no proper system, an appropriate time should be allowed for the preparation of such a system. It was suggested, furthermore, that when a system is prepared within the time suggested the details of the plan should be filed with the commission, and thereafter no change should be made, except on thirty days' notice.

Mr. Thomas, in presenting these suggestions, gave a list of companies represented at the meeting of the association at which the subject was discussed.

Underground Electrolysis in Chicago.

In a recent communication to the Chicago commissioner of public works, Mr. John Ericson, city engineer, includes a report by Mr. Ray Palmer, consulting engineer, on an investigation of damage to underground pipes and lead-sheathed cables caused by electrolysis from electric-railway return currents.

Extensive surveys were made in definite districts affected by surface and elevated railway return currents. The result of the survey showed that the electric-railway return conductors in the city are defective, or are insufficient at present to keep return current from damaging and destroying underground metallic pipes, etc. Both water-mains and gas-mains were found in cases to be much pitted. On one 36-in. water main the pits were ¼ in. or more deep. In one case it was found that 30 amp was flowing in a 24-in. water-main, and in another case 143 amp in a 36-in. water-main. It was found that the return conductors of the elevated railways do not have sufficient capacity at present to keep the electric current from straying, and it is recommended that large cables should be run from one end of the elevated structure to the other, tapping all track rails every 300 ft. The report states that while there is no practical way of determining how much water leakage is due to damage caused by electrolysis, yet there is probably a considerable loss from this cause. It is stated that the lead-sheathed cables of the city police and fire alarm system, telephone, lighting and power companies are being considerably damaged in different parts of the districts surveyed, and that the telephone and electric-light companies find it necessary to keep a force of men in the field working continuously in order to protect their underground investment from stray-current damage. The People's Gas Light & Coke Company has allowed return feeders to be attached to its mains, the feeders leading to the different railway-station busbars.

Stray currents were found to be carried by pipe in structural-steel buildings, and the report states that "if the defects in the surface, elevated and tunnel return circuits are properly repaired it will be an easy matter to protect the structural steel, pipe lines and other metallic work of buildings from stray currents by adding resistance in all pipe joints where they enter the building, shunting the building and connecting all entering pipe lines with insulated copper cables, and connecting the structural steel work to a low resistance to ground placed embedded in loose earth below the basement floor." For the protection of bridges it is recommended that "copper cables of equal carrying capacity to that of the return circuit at each end should be laid across the river at all bridges and tap the four rails at each end. Additional cables should be run from the rails on bridges to these main cables, so that the current released on the bridges will not stray or damage the structures."

In summing up, the report states that water-pipe mains have been seriously damaged in certain districts in Chicago, and that other sub-surface metallic structures, including cable sheaths, bridges and structural-steel buildings, are being damaged by electrolysis at the present time; that most of this damage is caused by the return circuits of the surface, elevated and tunnel companies, and that a great part of the damage is due to insufficient or defective return conductors.

It is recommended that the present ordinance limiting the difference of potential due to stray currents to 25 volts be changed so as to reduce this limit to 12 volts, and that the railroad companies be required to equip their return systems with insulated metallic-wire circuits and voltmeters, whereby at any time the difference of potential can be determined between the negative busbars in each station and the extreme limit of the return circuit in the corresponding feeding district. Also, that the companies be required to install a system equal to or better than a pipe and cable sheath drainage system, consisting of insulated copper wires, pipe straps, ammeters, etc., whereby the maximum amperes flowing in sub-surface pipes, etc., shall be limited to 10 per cent of the total output of the station. When the stray currents are reduced to an amount corresponding to 12 volts of maximum drop it is stated that pipes, lead sheath and other sub-surface metallic work can be protected by a properly installed pipe and cable sheath return "drainage" system.

It is recommended that the railway companies be required to make one or more of the following improvements, in order to conform to the limits of the above proposed ordinance: (a) Reconstruct all defective track work and install additional return feeders; (b) install a negative busbar system; (c) install a return current "drainage" system; (d) reduce the size of power plant in substation feeding districts; (e) insulate the railway return circuit. Should the railway companies decide to install "drainage" systems after reducing the return drop to 12 volts maximum, it is advisable that the gas, telephone, lighting and power companies work with the city to better their own electrolytic conditions at the same time.

Another recommendation is the installation of a number of large insulated cables between different points of pipe lines and the feeding station negative busbars in each district. All electric-railway river crossings and bridges should be so equipped with bonds, contacts and additional feeder cables, in order that no appreciable leakage shall result when cars are operated over the bridges or when the bridges are open. All special work, dead-end lines, steam-track crossings, surface and elevated line crossings, etc., should have jumper cables of equal conductivity to the rails. Additional return cables should be installed and tapped at regular intervals into the cross bonds and rails. The small amount of current which will stray into water-pipe lines after the improvements suggested are made can be diverted from the mains near the feeding station by means of cables connected to clamps on pipes. Pipe-line diverting cable should be lead-sheathed when laid in ducts and rubber-covered when insulated on poles.

Talk on Investments by Mr. Henry L. Doherty Before New York Electrical Society.

Mr. Henry L. Doherty gave a talk before the New York Electrical Society at the Engineering Societies Building on the evening of Nov. 16 in reference to the subject of investments. The talk was made as an informal presentation to the society of a plan which he has developed for the creation of a new spirit of thrift, particularly among workers in electrical properties. To show the effects of systematic investment for employees, and in that way for the country as a whole, Mr. Doherty gave illustrations of the earning power of money when the interest return is compounded.

In beginning his talk Mr. Doherty spoke briefly of the general business conditions in this country and of some of the forces which affect these conditions. His remedy for the condition of unequal distribution of wealth is to induce those who have not accumulated wealth to do something to better their position. The first question to be considered is whether it is possible for the majority of the people of this country to accumulate wealth, and to this question the speaker's answer was yes. The second question is whether it will be possible for people to accumulate wealth by making the necessary preliminary savings. Mr. Doherty believes that this is possible. Some of the largest fortunes have been accumulated after small beginnings; the turning point in the history of such fortunes has been when the money was a very small sum. The third question is how saving on the part of workers on small or moderate salaries is to be effected.

Mr. Doherty then proceeded to answer the last question. He referred first to the principles of political economy and to the growth of recognition of property rights. In the course of his argument he showed that everybody should have funds to rent as well as hands or brain with which to work. He said that there is no way of keeping the workingman employed except by the continuation of building operations. If employment of labor should be reduced to the point represented by the means of those who have funds to buy there would be no employment for many. Prosperity in the country depends on the ability to continue building for the future. There must be continued development and accumulation for the future. More and more there is production by property rather than labor. The telephone is substituted for the messenger, mechanical power and water-power for labor. The extent to which wealth has been accumulated in this country was then considered. The workers earn an average amount estimated at $22,000,000,000 annually, or $550 each. The accumulated wealth of the country is but $121,000,000,000, much of which is invested in securities of low-income value, such as government and municipal bonds, and, assuming a return of 6 per cent on this accumulated wealth, the annual income from the ownership of property is but about one-third of the earnings of labor. Mr. Doherty then showed the percentage of wages that would have to be saved and invested at various rates of interest to equal in forty years the wealth which has already been accumulated in the 300 years of the settlement of this country.

It was an argument in encouraging people to save to consider that all opportunities had not passed, and, in fact, that perhaps the greatest opportunities of all are just beginning to be apparent. In referring to the modern efficient tungsten lamp, the speaker said that this lamp gives one-half of 1 per cent of the efficiency of the coal in the mine from which the power is secured. Every change in life brings opportunities to men to get their share or more of wealth. Mr. Doherty wanted not only to make it advantageous for those now represented as capitalists to go ahead with development work, but to make it equally advantageous for those who are not now capitalists to become small investors. A great many people believe that they must have government or municipal bonds to secure safety in investment, but an interest return of only 2 or 4 per cent largely destroys the encouragement for saving. Business cannot exist and support the organizations required if only these small returns can be secured. Nothing is of more importance to the American people than to know how to invest money properly. The great mass of American people are not investors, because they do not, like the French people, know how to save. They are not savers because they would not know what to do with the money if they had it saved.

At present it is possible, Mr. Doherty said, to make safe, conservative investments on a 7½ per cent interest basis. To show the difference between the results of interest compounded at that rate and at lower rates, Mr. Doherty said that $1 invested for seventy years, with interest compounded quarterly at the rate of 2 per cent, would become at the end of the period $4.01; at 4 per cent the amount would become $16.26; at 7 per cent the amount would become $128.72, and at 7½ per cent the amount would become $181.52. It was then shown by Mr. Doherty that if a pur-

chaser of securities buys those paying the higher rates of interest, which necessarily involve more risk than the lower interest-bearing securities, he can still afford to lose a certain percentage of his original investment at the end of each year, and come out as well in the end as if he made the investment which promised only the smaller rate of return. Safety can be secured largely by diversity in the investments. If the great body of people in the country are to be induced to save and become investors the habit will have to be formed largely through employers of labor. Mr. Doherty believes that employees should own the securities of the companies for which they work, although some men do not want to take the responsibility of having their employees invest in securities of their own company. If the wage earner is to be made an investor and the principles of thrift are established, the results will be a great factor, if not the greatest factor, in solving the ills from which the country has been suffering.

Valuation of Public-Utility Properties.

An interesting joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers was held on Nov. 22 to discuss the timely and complicated subject of valuation of public-utility properties. The feature of the evening was a carefully thought-out paper by Mr. Frank F. Fowle, of Chicago, on "Going Value." Mr. J. G. Wray, chief engineer of the Chicago Telephone Company, presided as chairman of the Chicago Section of the Institute, and he introduced Mr. Ralph W. Pope, honorary secretary of the Institute, who happened to be in Chicago and who extended a few words of greeting to the assembled engineers.

Mr. Fowle's paper was a survey of the whole situation in relation to what has been called "going value," and space is available in the present summary for only a few of the principal points brought out in an able review. In the beginning the speaker said that there were many honest differences of opinion on the subject. Going value is as much property as though it had physical existence. There is, however, no universally accepted theory as to just what constitutes it.

First, the author considered briefly the economic aspect of the subject and gave definitions of economists to show what "value" is. He then sketched the theory of rate regulation and said that he should consider principally the theory that rates should be based on cost of service (the theory on which regulation is based) rather than on free commercial competition—the "value of service" theory. Tangible and intangible values were next considered and analyzed, and Mr. Fowle remarked that it is now well recognized that an established business costs more than the actual physical plant. What have been called "intangible values" consist of the valuations put on franchise, going value and good-will, and these values are difficult to separate. A franchise is now regarded as a contract rather than a valuable gift, and, as for "good-will," it is usually thought there is no value to be attached to it where the customer has no element of choice in seeking service in a particular field.

The nature of "going value" was next taken up, and the speaker said that it is generally taken to be that element of value created by an active going business in addition to the value of the physical plant. Several methods of determining this value have been proposed, and six of these were taken up in detail.

Capitalizing net earnings was spoken of as the first method. This method is the natural one to apply in a private business, but it is not usually considered equitable as applied to a public-service utility operating under a public franchise.

The "reproduction of net earnings" method was the second plan considered, and to this considerable attention was devoted. This plan is used in water-works valuation especially, but is of general application to all public utilities. With the aid of diagrams Mr. Fowle told how this method, which is an old and familiar one to appraisers of utility properties, is arrived at. If, for instance, it will take seven years for a new plant to reach the proportions and earning capacity of the old plant under valuation, then by a calculation of the net returns during these intervening seven years and by a summation of these returns the "going value" will be reached under this method. The period necessary for the new plant to overtake the old plant may vary from five to eleven years, and in general the longer this period the greater will be the going value. This method has never been sanctioned by the Wisconsin Railroad Commission, and Mr. Fowle confessed that he was yet to be convinced that it is the correct method. A going value under this theory might be figured out for an unprofitable business, and some other objections were enumerated. One of these is that this method measures no element of value that can be considered under the general cost-of-service theory of rate making.

Taking up the third method of arriving at going value, the speaker said that it has been called the "capitalized losses" method. This is the plan approved by the Wisconsin commission and one which Mr. Fowle appears to favor. Accurately, it should rather be called the capitalized value of deferred profits. This may be criticised as putting a premium on bad management, for it takes into account the losses of the earlier years in developing the business. However, the Wisconsin commission says that local circumstances in each case should receive consideration. The principle must be applied with great care to see that no injustice is done either way. The Beloit case, Mr. Hagenah's analysis in the Chicago gas and other cases were cited. This method, too, is open to objections. Its underlying motive is a desire to do justice to the pioneers in the industry, but engineers and appraisers should proceed with caution and use the method with good judgment and a due regard for equity.

As the fourth method, Mr. Fowle enumerated the "merged securities" plan. Here duplication of properties enters into the problem. This duplication is due to public authorization. Therefore, when a consolidated company comes under regulation the value of the unnecessary duplication of capital must be considered. If the public is responsible for this duplication it seems just to allow a going value to the extent of the duplication, but questions of equity and public policy are involved and it is to be remembered that duplication value is not really going value.

The "cost of development" method was taken up as the fifth plan. The cost of development is almost always present, and usually is most burdensome in the early years of the business. It is usually treated as a part of operating expense, and so may become an unfair burden on a company when, for the purpose of rate making, the history of the early years of that company is analyzed. Selling cost is a legitimate outlay which must be recognized. Perhaps it is not "going value" in the broad sense.

Several miscellaneous plans were grouped together under the sixth division of the subject. One of these is to take one-half of one year's gross receipts as the going value. Another is arbitrarily to assume one-third of the value of the physical property as the going value. A third places this figure at 27 per cent instead of one-third. Still another basis is a certain fixed sum per connected customer, and in one case this figure was assumed to be $30. A further proposal is to fix going value at an amount anywhere from one-half to the full sum of one year's gross receipts, according to circumstances. These methods, however, while of some interest, are not admissible under the general cost-of-service theory in rate making.

At the end of his paper Mr. Fowle drew the following conclusions:

(1) Under the cost-of-service theory we seem bound to recognize every element of actual cost for both tangible and intangible property which is legitimate, reasonable and necessary.

(2) Going value, under the cost-of-service theory, cannot be supported by capitalized net earnings in excess of a fair return on the cost value of the property.

(3) Rigid rules for measuring the legitimate going value, if any, under the cost-of-service theory cannot safely be laid down, because the local circumstances in each case are different, and each issue should be treated on its merits.

(4) The general test for value of any kind, under the cost-of-service theory, is always the cost, but this may be tempered by the great desirability of distributing justice and equity to both the public and the utility companies in equal measure.

Discussion.

After some introductory remarks by Mr. Wray, Mr. Benezette Williams, an engineer who has had wide experience in the appraisal of water-works and who is a past-president of the Western Society of Engineers, was called upon to open the discussion. Mr. Williams made an interesting speech. He said that the fundamentals of this problem must not be lost sight of. The capitalization of net earnings to determine going value has no standing in the courts or before public-service commissions and may be dismissed at once. In the cost method of determining the value of a public utility the value is arrived at by ascertaining the cost of construction and adding to it the cost of developing the business. That is all there is to it. Here, properly speaking, there is no such thing as going value at all. The confusion of terms is one great trouble encountered in this discussion. The "cost" method outlined by Mr. Williams has been presented to nearly all the courts of the land. The speaker recalled several water-works cases, particularly the Kansas City case of 1894. The city here, as all cities do, contended for the "junk theory" of appraisal. Justice Brewer decided that the "junk theory" was not admissible, neither was the reproduction-cost theory nor the capitalizing-of-earnings theory. The plant is worth more than the cost of reproduction because it has a business. This added value, said Mr. Williams, must necessarily have to do with the future. How is this future value to be measured and described? Obviously, it is the excess in revenue that an operating plant will produce over a corresponding new plant in the same field. In other words, the old plant produced a revenue from service that no other plant can give until after a considerable lapse of time. The total revenue during this lapse of time is the only thing that can be called "going value." Mr. Williams said in effect that the Wisconsin commission has wabbled on this question, its later decisions differing from the earlier ones. It is to be remembered that it makes a difference whether a plant started up under the old conditions or under the modern plan of regulation.

A public utility is never complete until the point of saturation is reached at a schedule of rates that will bring proper remuneration. Up to that time years with deficits are usually recorded. A public utility usually cannot be made to pay from the beginning unless the rates are prohibitive. More than half of the present-day trouble arises from the use of terms. Take "good-will," for instance; there is no such thing in relation to a public utility. Also consider "tangible" and "intangible" values. Property is tangible, but no value of any kind is tangible; it is constantly changing and cannot be tangible. The "going value"—the service the plant is rendering—is the most tangible element of all that enter into into a public utility. The term "going value" is unfortunate; it does not express the thought intended to be conveyed. Mr. Williams believes the true term should be "business value," or "revenue value," or "service value." Real going value is the total value of the plant as a going concern.

Mr. Wray asked if there were not, after all, such a thing as "good-will" in the survey of the public-utility situation. For instance, cannot a man exercise his good will in choosing whether he will ride to his destination on a surface line, an elevated railway or a steam railroad? Can he not select between gas, electricity or kerosene oil for lighting, or may he not send his message by telegraph, telephone or mail?

Mr. Williams explained that he referred to a utility in its own field, as, say, a telephone company, not as comparing a telephone company and a telegraph company.

Mr. J. W. Alvord, also a past-president of the Western Society of Engineers, pointed out that the cost of creating revenue, while a vital item, is not always taken into account in figuring cost. Mr. Alvord believes that the Wisconsin commission has put itself at variance with a long series of decisions in the courts in the method it has evolved in arriving at the value of public utilities. As an illustration, the speaker said that we may consider that there are several "yardsticks" available for measuring this value. These yardsticks have been enumerated by the courts and are mentioned in Mr. Fowle's paper. The Wisconsin commission and other public-service commissions have mixed up the yardsticks. Let us, said the speaker, be logical in using each of these available methods. Let us consider each logically to its end. When all the conclusions have been reached by using the various methods, let us compare the results and reason the matter out judicially and see which conclusion an intelligent, fair-minded man decides will come nearest the real value of the plant. Mr. Alvord's definition of going value is "the value of a created income."

Mr. W. J. Norton, of the Commonwealth Edison Company, Chicago, formerly of the Public Service Commission of New York, spoke briefly, citing particularly the Des Moines gas case.

Dr. M. G. Lloyd, of Chicago, referred to the confusion of terms. He thought that allowance for deferred profits should not be called going value.

Mr. J. R. Cravath, of Chicago, defended the Wisconsin commission. He said if that commission has varied from the decisions of the courts perhaps it is because it has looked at the situation from the viewpoint of the "square deal" to both the public and the investors rather than from the severely legal or technical point of view. He said that the Wisconsin commission is to be commended for this sensible attitude.

In the few minutes available at the closing Mr. Fowle said that he agreed with Mr. Williams that it would have been better if going value had been construed in the first instance as total value. There is some fallacy, the speaker contended, in the reproduction theory. An old plant may be more attractive as an investment, but not more valuable. Logic, he said, may be carried to an absurd extreme in determining plant valuation; for instance, in computing population the curve may be carried back to a time when there was no population, and so the severely academic method may be made ridiculous.

Electric-Service Rates and Municipal Ownership.

Mr. C. Nesbitt Duffy, comptroller of The Milwaukee Electric Railway & Light Company, spoke on the subject of "Some Features of Electric-Service Rates and of Municipal Ownership" before the Milwaukee company section of the National Electric Light Association Thursday evening, Nov. 23, his remarks being occasioned by a series of questions on public utilities recently put by a debating team at the University of Wisconsin. Mr. Duffy first discussed the elements which may affect the prices charged for

electric service, including kind of plant, distribution system, class of service, local costs, etc., and then described briefly the commercial methods of the Milwaukee company.

The most important special problem faced by an electric utility, said the speaker, is that of increasing its plant, generating capacity and distribution lines to keep step with the industrial, commercial, civic and social advancement of its community. A private company can solve this problem better than a municipality because it is not restricted in the administration of its business by the limitations of a city charter or other legislative enactments. Again, all of the knowledge, experience, ability and resourcefulness at the command of a private company can be specialized and concentrated on this problem from an engineering, executive and financial standpoint. The average municipality, on the other hand, has many other special problems, of equal or greater importance to the community. These demand immediate attention and the exercise of all of its legislative and administrative functions, as well as its financial resources.

The establishment of a municipal street-lighting plant in Milwaukee, for which bonds are now being issued, was actuated, said Mr. Duffy, by political, not economic, reasons. Unfortunately, he added, voters are not usually guided by reasons, but by political influences and prejudices, often founded on ignorance or misrepresentation of facts.

The principal weak point in any agitation for a municipal plant, he went on, is the erroneous idea that the city can do its public lighting at less cost than it can be done by a private company, when exactly the opposite is the case. Taking the estimates of the city's engineers in the Milwaukee case, the cost of lamp operation will be increased 31 per cent, or $40,000 a year, over the present contract with the private company, which was made six years ago and has been extended temporarily.

It is not generally known or understood what an important part "fixed charges" play in the cost of electric service, said the speaker. "Fixed charges" are approximately 60 per cent of the total cost of conducting the business. "Fixed expenses" (fixed operating expenses and fixed charges) are approximately 80 per cent of the total expenses, "variable expenses" being only 20 per cent. This explains why a municipal plant cannot do its public lighting as economically as a private plant, and also why it is necessary for a private company to make "minimum monthly charges," regardless of whether any electric energy is consumed or not. The necessity for this is apparent when it is known that approximately four-fifths of the total expense of conducting the business is "fixed" and has to be met by the municipal or private plant, regardless of what the consumption of electricity or the income derived therefrom may be. The practical advantages of private ownership over municipal ownership Mr. Duffy mentioned thus:

(1) Ability of the private company to command unlimited capital, if it is properly safeguarded and a reasonably adequate return thereon is assured, not only for the original installation of a plant and equipment of the best type and adequate capacity for the needs of the community, but also for all necessary additions and betterments thereto, as well as the extension of the service and the development of the business, unhampered by the limitation of city charters and other legislative restrictions.

(2) Economy and superiority of private service, due to the construction of the best plant at the lowest cost that money and skill can produce; the high standard of its maintenance; the economy and efficiency of its operation; the prompt, courteous and satisfactory treatment of consumers, and the efficiency and stability of its managers and employees, who, immune from political preferment or changes, are selected solely for their qualifications for the discharge of the duties and responsibilities of the positions to which they have been called.

(3) The development and extension of the business in keeping up with the reasonable needs of the community for enlarging its activities of every kind—to the end that the advantages of the service may be placed within the reach of the greatest number of people, since the greater the volume of the business the less the cost of the service will be to the users.

There are other disadvantages of municipal ownership, said Mr. Duffy, which are of more vital importance to the public and more far-reaching in their ill effects to the community than those already referred to. One of these is the danger of rates being made too low, owing to ignorance of the actual cost of furnishing the service or utter disregard of what the cost may be. The fixing of rates is thus sometimes treated not as an economic question but as a means to an end, that end being the gaining of popularity with the public for the purpose of the political advancement of the party in power. The fixing of rates for electric service by a municipality under these conditions may temporarily convert a community to utopianism or socialism, but there will be a rude awakening when the users of the service are compelled to pay higher rates and the taxpayers are forced to make good financial deficits resulting from an attempt to give something for less than it can be produced.

In addition to the practical disadvantages of municipal ownership briefly referred to, said Mr. Duffy in closing, many objections could be pointed out from an ethical standpoint to show its absurdity, its impracticability, as well as the injustice of the burdens it necessarily and eventually imposes upon a community without any compensating benefits.

Public Service Commission News.

NEW HAMPSHIRE COMMISSION.

In a signed statement outlining the work of the board since its establishment in June, 1911, Chairman Edward Niles, of the commission, points out that the amount of business already brought before the board shows clearly that there is a public demand in the State for its services. Among electrical and related matters which have been brought forward are the inadequacy of telephone service; poor quality and excessive price of gas; consolidation of telephone companies; capitalization of electric companies and location of lines; assessment of land damages caused by overhead circuits; street-railway fares and schedules, and the extension of telephone and electric-lighting systems into additional municipalities. The statement indicates that not a single case where the price or quality of electric service has been questioned has been brought before the board, pointing to a state of unusual harmony between the central stations and their customers.

WISCONSIN COMMISSION.

In a decision in the matter of an action to restrain the Railroad Commission from enforcing the penalty provisions for a non-compliance with the provisions of the public utilities law by the Cawker Building Company, of Milwaukee, the Supreme Court recently held that the respondent company was not a public utility, and consequently not subject to commission jurisdiction. The Cawker Building Company is the owner of the Cawker Building in the city of Milwaukee. When the building was erected a steam plant was installed to provide heat, lighting and motor service for the benefit of the tenants. It was subsequently found that to operate economically it was necessary to utilize the full capacity of the plant. To do this it was necessary to dispose of the surplus energy, which was done by contract with three adjoining manufacturing concerns. This energy was sold in competition with a public utility operating under commission regulation and under an indeterminate permit granted by the commission.

The commission took the ground that the Cawker Building Company was a public utility according to its interpretation of the statutes. In its decision the court held that the mere furnishing of energy by a private individual or corporation to a few neighbors in the vicinity did not make that concern a public utility either under the letter or under the spirit of the law. In the present case it was held that the furnishing of energy was incidental merely and limited to the concerns in question. The court did not attempt to define or to fix a standard as to what constituted a public utility under the law, but was of the opinion that each case must depend upon the circumstances involved. This decision is not entirely satisfactory to the commission, for the reason that it does not fix the status of the many similar concerns now doing business in competition with existing commission-controlled utilities. These smaller concerns are of every gradation in size, and apparently it will take a number of years for the commission to learn over which ones it has jurisdiction.

The commission has refused to change its previous order in the case of the city of Neenah versus the Wisconsin Traction, Light, Heat & Power Company, on a rehearing of the case applied for by the respondent on the ground that it had additional evidence concerning the plant valuation. In the testimony at the rehearing the company claimed that the valuation of $320,000, upon which the commission based its previous order of a 25 per cent rate reduction, is lower by more than $300,000 than the actual price paid for the original property and the subsequent additions. The company based its claim upon the fact that when the various properties now consolidated by the respondent were acquired the total amount paid, including subsequent improvements, was $663,570, or a value of $557,397, exclusive of improvements. The commission's valuation was based upon the value of the physical properties at the time of the consolidation, but the value upon which the former rate order was based was higher than the physical valuation.

According to the facts in the case, the approximate physical value of the entire property purchased with the $557,000 of securities would reach about $266,185, of which about $219,630 was assignable to the gas plant. The commission held that a price over $500,000, if such price was paid for the respondent's gas plant, did not represent a reasonably prudent investment upon all of which the respondent is now entitled to earn. The average investment in gas plants of similar size in the State per thousand cubic feet of gas sold is $5.11, with a maximum of $8.51. This figure, based upon the respondent's alleged valuation, would be $12.87. All facts in the case, including the earning value of the plant as based upon past operations, tend to the conclusion that the plant when purchased was worth far less than the amount now alleged to have been paid. The commission was inclined to the opinion that the securities paid over as a consideration for the property did not represent or even approach in value the amount shown by their faces. Whether the company is over-capitalized or whether the excess in price over a reasonable value was actually paid and represented an unfortunate investment was considered immaterial, and the commission was decidedly of the opinion that such over-capitalization or over-investment should not be saddled upon the respondent's consumers. The case was dismissed and the company ordered to put into immediate effect the rate schedule as contained in the commission's previous order.

OHIO COMMISSION.

The Ohio Public Service Commission has before it now the question of whether the small mutual telephone companies are entitled under the new law to interchange of business and physical connections with the regular companies. It seems that on the surface the law provides for this, but the independent companies of the State have joined hands and declare they will fight the matter through the Supreme Court rather than allow these small companies to force this point where the large companies do not desire it. On the other hand, it is charged that it has not been so long ago since the large companies were seeking this business with considerable anxiety. The Kilbourn Mutual Telephone Company has asked the commission to order the New Ashley Telephone Company, the Citizens' Telephone Company of Delaware and the Sunbury & Galena Telephone Company to permit interchange of service, and the hearings took place before the commission last week.

In regard to this matter H. P. Folsom, vice-president of the Citizens' Telephone Company, of Circleville, said that if it is decided that the mutual companies may force interchange of service the larger companies will be forced to maintain them as well as their own systems, as they are poorly equipped and are not kept in proper repair to take care of the service. If they are forced to pay a proper rate on interchange of service, he said, they could not exist. Mr. Folsom argued that it would be a very one-sided arrangement and that the independent companies will fight through the Supreme Court to annul the portions of the new law pertaining to the interchange of service if the commission decides that the mutual companies have the right to force this issue.

The Bucyrus Light & Power Company has filed a complaint with the commission asserting that the service rate fixed by the Council of Bucyrus is unfair. The ordinance fixing the rate was enacted some time before the public utilities law was passed, and the city contended in the hearing last week that the commission had no authority to interfere for this reason. It is possible that the case will be taken into the courts, no matter what the decision of the commission may be.

A petition is being signed at Hamilton asking the commission to take steps to compel the Cincinnati & Suburban Bell Telephone Company to permit subscribers of the Home Telephone Company of Hamilton to use its toll lines under the public utilities law. The petition has been signed by many prominent business men of the place.

The commission has issued authority to the Springfield & Washington Electric Railway Company to issue $200,000 stock at par and $300,000 of thirty-year bonds to be sold at not less than $85. This is perhaps the first instance in Ohio where this class of stock has been sold at par. It is said that this road will be extended from South Charleston to Washington Court House at once.

The commission has sent notices to 360 public-utility companies to file their tariff charges and service rates at once or expect punishment. These should have been filed by Oct. 1, but because of the newness of the law allowances have been made. If within a reasonable time this information has not been filed the names of the companies will be certified to the Attorney-General for action. The fine is $1,000, and each day of omission may be construed as a separate offense.

MASSACHUSETTS COMMISSION.

The Fitchburg Gas & Electric Light Company has applied to the Gas & Electric Light Commission for authority to increase its capital stock by an amount not exceeding $131,350, covering 2627 shares of the par value of $50 each, such new stock or the proceeds from its sale to be used in paying floating indebtedness already incurred for new construction, extensions and permanent improvements and in meeting the cost of additional plant and property required in the company's business. The directors have determined a price of $85 per share at which the new stock is to be offered to existing stockholders, subject to the board's review. The amount of money estimated as necessary for the purposes of the issue is about $223,295.

The Haverhill Electric Company has petitioned the board for the right to issue additional capital stock of the par

value of $111,700, covering 1117 shares at $100 each, the price fixed by the directors being $130 per share, the estimated amount required for purposes similar to the Fitchburg petition being $145,210.

The Malden Electric Company has petitioned the board for authority to issue 2070 additional shares of stock of the par value of $100 each, the money to be devoted to meeting the cost of extensions and improvements and liquidating floating indebtedness. The directors have fixed the price of the stock at $145 per share, about $300,150 being required by the company.

The Malden & Melrose Gas Light Company has petitioned the board for authority to issue additional stock of the par value of $40,000 and to consolidate with the People's Gas Light Company, of Stoneham.

The Springfield Gas Light Company has applied to the commission for the right to issue additional stock to the par value of $135,000, to meet the cost of extensions and improvements; for authority to issue new stock to the par value of $111,000, for consolidating with the Chicopee Gas Light Company, and for permission to consolidate the latter organization.

The Boston Transit Commission recently gave a hearing regarding the location and character of the westerly terminus of the new subway to be built through the Back Bay district of Boston in place of the so-called Riverbank subway. The new subway, which will run mainly under Boylston Street, will be built in the near future by the Boston Transit Commission, and will cut down the running time of electric cars from westerly suburbs of Boston in and out of the city proper about ten minutes.

Hearings have been continued during the past week before the Railroad Commission upon the detailed locations desired by the Boston & Eastern Electric Railroad Company, which has been authorized by the Legislature to build a high-speed line between Post Office Square, Boston, and the north shore district of Lynn and Salem. Interest has centered upon a route through the large manufacturing city of Lynn. The original plans of the company called for the building of a semi-subway for underground electric operation through West Lynn. At the latest hearing the company agreed to a route beneath Lynn Common or North Common Street, which will bring the benefits of the road nearer the business center of the city.

An important hearing was held by the Railroad Commission on Nov. 23, at which the Boston Elevated Railway Company appeared on behalf of the establishment of an electric express and freight service on its surface lines in Boston. Over 500 persons of high official and private position appeared in support of the project.

NEW YORK COMMISSION.

The Public Service Commission, Second District, has received an application from the Lewiston & Lake Ontario Shore Power Company for permission to exercise franchises in the villages of Lewiston and Youngstown and the towns of Porter and Lewiston, and for permission to begin construction of its plant and system for transforming and distributing electricity for all purposes. The applicant company proposes to purchase electricity which is for sale throughout the towns of Lewiston, Porter and Wilson, Niagara County, from the Niagara, Lockport & Ontario Power Company, and asks the commission to authorize the sale of $25,000 of stock, the proceeds to be used to acquire the necessary real and personal property for right-of-way, distribution system, transformer stations and equipment. Substations will be located in Lewiston, Youngstown and Ransomville. A hearing on this matter has been appointed to be held at Buffalo on Dec. 1.

The commission has received a complaint from George Duchscherer, proprietor of the Hotel Touraine in Buffalo, alleging that the New York Telephone Company has refused to connect its trunk lines operated in connection with a switchboard of that company in one building of the hotel with the lines of the Federal Telephone & Telegraph Company at its switchboard in another building, in order to enable the hotel to give its patrons service over the lines of both companies from the single instrument in their rooms. The complaint has been served upon the company and an answer is required by the commission within twenty days.

CURRENT NEWS AND NOTES.

Baltimore A. I. E. E. Meeting.—The November meeting of the Baltimore Section of the American Institute of Electrical Engineers was held in the Physical Laboratory of Johns Hopkins University on Friday evening, Nov. 24, at which a paper entitled "Photography with Invisible Rays" was presented by Prof. R. W. Wood, of the university. By invitation many members of the Engineers' Club of Baltimore were present.

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Edison Would Refuse Nobel Prize.—At the annual meeting of the John Ericsson Memorial Society of Swedish Engineers Mr. Edward H. Johnson, the former business associate of Mr. Thomas A. Edison, stated that the great inventor would refuse the Nobel prize if offered to him. He added that Mr. Edison thoroughly appreciated the honor attached to the award of the prize, but believed that it should be bestowed upon those who otherwise would not have sufficient means to develop their work commercially and make it profitable to the world.

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N. E. L. A. Convention Arrangements.—During the National Electric Light Association convention to be held in the state armory at Seattle June 9 to 15, 1912, an impressive exhibit will be made of electrical apparatus, as has been done in former years. The floor area to be devoted to the exhibition will be about 8000 sq. ft. The convention hall in which the meetings will be held will have about 6000 sq. ft. of floor area in addition to a gallery. Two other large rooms are available for the parallel sessions which will be conducted according to the plan used so successfully in New York. Long before the convention date the total membership will have passed the 10,000 mark, which it is now approaching steadily and rapidly.

* * *

Conference of Hodenpyl, Hardy & Company's Operating Officials.—Operating officials of the Union Railway, Gas & Electric Company and the Commonwealth Power, Railway & Light Company, which operate in Wisconsin and Michigan respectively and are under the management of Hodenpyl, Hardy & Company, 7 Wall Street, New York City, met at the Hotel Sherman, Chicago, Nov. 13-16 inclusive, for conference on matters relating to operation of the various properties. About 100 were present, including the staffs of the New York and Detroit offices. Papers were presented on operating and accounting subjects, and a very valuable address was made by Mr. C. P. Winslow, of the United States Forestry Commission, upon the preservation of wood ties and poles. A dinner was held on Wednesday evening, Nov. 15. The sessions were highly interesting and beneficial throughout, and it is planned to make the conference an annual affair. Among those in attendance at the sessions were Messrs. Bernard C. Cobb, president of the underlying companies; William H. Barthold, E. J. Bechtel and William M. Eaton, vice-presidents; H. G. Kessler, general auditor, and S. E. Wolff, assistant secretary and assistant treasurer.

ADDITIONAL HIGH-PRESSURE FIRE PUMPS FOR NEW YORK CITY.—The city of New York is now installing an additional high-pressure motor-driven fire pump in each of its two pumping stations, making, when completed, six such pumps in each station. The buildings were originally laid out for eight pumps.

* * *

COMMONWEALTH EDISON SECTION, N. E. L. A.—Mr. H. M. Byllesby is scheduled to address the Commonwealth Edison Section of the National Electric Light Association in Chicago on Dec. 5. This will be the first of a series of meetings at which the members of the section will listen to addresses by prominent public-service executives, including Mr. Samuel Insull, Mr. B. E. Sunny and Mr. B. I. Budd.

* * *

MEETING OF THE SCRANTON COMPANY SECTION.—The regular monthly meeting of the Scranton Company Section of the N. E. L. A. was held in the Board of Trade Building, Scranton, Pa., on Nov. 23, the attendance being over 200. The speaker of the evening was Mr. T. C. Martin, who spoke of the work of the N. E. L. A. throughout the country. One of the features of the meeting was a demonstration of first-aid-to-the-injured work by representatives from the Brisbin colliery. Mr. H. L. Badger also addressed the gathering, taking as his topic "Results of Organization, Both Social and Technical, with the Bell Telephone Company." Entertainment and refreshments were provided at the close of the meeting.

* * *

LOS ANGELES A. I. E. E. SECTION.—The regular monthly meeting of the Los Angeles Section of the American Institute of Electrical Engineers was held Nov. 21, with an attendance of about seventy-five local members and visitors. Prof. Harris J. Ryan, Leland Stanford University, presented a paper entitled "Polarity in Polyphase Current Circuits," accompanied by many diagrams. Prof. R. W. Sorenson, of Throop Polytechnic Institute, Pasadena, discussed the paper and pointed out the practical use of the method in calculations in regular practice, relating particularly to compensators or auto-transformers. The next regular meeting of the local section will be held on Dec. 19, when the subject of "Public Service" will be discussed by Mr. T. B. Comstock, engineer of the Board of Public Utilities, Los Angeles, and by Mr. Paul Shoup, vice-president and general manager of the Pacific Electric Railway Company.

* * *

ELECTRICAL SHOW AT LOS ANGELES, CAL.—The Los Angeles Electrical Exposition opened in the Shrine Auditorium Nov. 25, with approximately eighty exhibitors. Among these are the United States government, which has four exhibits, including a most interesting collection of models from the Smithsonian Institution, and the Southern California Edison Company, which occupies a prominent booth in the building. The usual array of vacuum cleaners and other labor-saving and domestic appliances are on exhibition, as well as models of many of the best known electric carriages on the market. The electrical decorations are particularly effective and striking, more so than would have been possible had the original intention of holding the exposition in Fiesta Park been carried out. The attendance on the opening night was all that could be desired. The show will remain open till Dec. 9.

* * *

PATENT OFFICE DELAYS.—Hon. E. B. Moore, commissioner of patents, in his annual report just issued makes a strong appeal for the enactment of legislation requiring that an application for a patent shall be prosecuted within six months of any action of the Patent Office. A bill to this effect was introduced into Congress, but was strongly opposed by some patent attorneys. The present period within which the applicant is allowed to amend is one year, and under the existing practice there have been many instances of cases being amended just within the one-year limit in order to keep them alive, they thus serving as dragnets in many cases to catch inventions along similar lines which may be subsequently applied for, thereby involving inventors in expensive interference proceedings. The commissioner states that the office has been severely criticised recently, especially in the last year or two, for allowing applications, particularly those owned by corporations, to rest in the office for such long periods as really to have the effect of extending the patent period in case such applications are later passed to issue. Instructions, he says, have been repeatedly given to the examining corps to get rid as far as possible of all such cases as are delayed apparently by the applicant or his attorney, and had this bill passed it would have almost entirely overcome the criticism against the office.

* * *

PHILADELPHIA N. E. L. A. COMPANY SECTION.—On Nov. 2 the Comedy Company of the accounting department branch of the Philadelphia Electric Company N. E. L. A. Section cut loose from staid Quaker ways and the theories of higher accounting and presented the comedy farce "Her Gloves" to an appreciative audience of more than 500 persons. A dance followed and was a very enjoyable part of the evening's entertainment. At the November meeting of the commercial branch the subject "Salesmanship from an Insurance Man's Standpoint" was presented by Mr. Frederick C. Jones, of the Equitable Life Assurance Company. Mr. Jones called attention to many points of similarity in the work of the insurance man and the light and power salesman, indicating methods of approach and the necessity not only of studying the prospective customer from a business viewpoint but also of becoming thoroughly familiar with his individual habits as a means of securing that first attention which means so much in salesmanship. At a meeting of the meter department branch on Nov. 3 Mr. John V. Matthews presented a paper on "Three-Phase Systems and the Measurement of Power," in which economy of operation and theory of distribution were thoroughly covered. At the regular meeting of the accounting department branch Mr. Byron B. Smith presented a paper on "Accounting for Purchases," which laid stress on the importance of co-operation on the part of all who in any way become involved in the using of material, to the end that job and storehouse records may be accurately kept and that all may be traced through the accounting records. Mr. Smith convinced his hearers that departmental whims and "red tape" are not carried beyond the point of necessary information. The monthly general meeting of the section was held on Nov. 20, with Dr. C. P. Steinmetz as guest. Previous to the meeting Dr. Steinmetz was entertained at an informal dinner, about sixty members and guests attending. At the meeting the subject of "The Effect of Reactance on Alternating-Current Circuits and Apparatus" was treated by Dr. Steinmetz, the discussion being participated in by Mr. Snook, of the American Institute of Electrical Engineers, and Mr. A. R. Cheyney, of generating station "A." At the December meeting Mr. A. H. Armstrong will address the section on "The Coming of the Electric Locomotive." The death of Mr. Caryl D. Haskins has caused much sadness among his many friends in the Philadelphia Electric Company Section. He was an honorary member of the Metermen's Society, and that body has passed a resolution deploring his untimely death. Mr. Haskins was to have addressed the Philadelphia Electric Company Section at the February meeting next year.

Gasoline Street Lighting in Chicago.—By an order of the City Council of Chicago, Mr. Carroll, city electrician, has been authorized to accept the bid of the American Development Company to supply gasoline street lighting for the year ending Aug. 31, 1912, at the rate of $26.64 per lamp per year.

* * *

Federal Relation to Water-Power Development.—Mr. Walter L. Fisher, Secretary of the Interior, is reported to have said, in addressing the National Waterways Commission in Washington, D. C., on Nov. 23, that the government should take no steps to prevent the development of water-powers by private corporations planning to utilize the energy by electricity. Rather, the Secretary is quoted as saying, federal regulation should be made strong enough to protect the public interest. Investors should be assured of a sufficient return to attract capital toward hydroelectric development.

* * *

Electric Service on the Canal Zone.—As the Balboa power station of the Canal Zone on the Isthmus of Panama has been overloaded to the extent of about 20 per cent, the load from the villages of Corozal and Diablo has been transferred from that power house to the one at Miraflores. The Balboa plant, supplying all the electric light and power for Balboa, East Balboa and Ancon, is a temporary plant and will be dismantled, according to the present plan, within two years. The Miraflores plant, on the other hand, will be permanent. The Balboa plant supplies alternating current at 60 cycles, while the output of the Miraflores station is at 25 cycles.

* * *

Proposed Cleveland Municipal Plant.—Mayor-elect Newton D. Baker of Cleveland, Ohio, has opposed immediate arrangements for the issue of $2,000,000 bonds for the erection of a new municipal lighting plant, as provided by vote at the recent election. Mr. Baker seems to have plans of his own in regard to this matter and has even refused the aid of the present city administration in getting information on what has been done by the two small plants already in operation. The trouble probably lies in the fact that he does not want the present City Council to take any action upon the matter. It is probable that negotiations will be resumed between the Cleveland Electric Illuminating Company and the Cleveland Railway Company whereby the additional power needed for the operation of the railway lines may be purchased from the former company's large new station. These negotiations were begun a year ago, but the illuminating company's figures were then considered too high. Vice-president Scovil stated a few days ago that the figures were not final and that the average price would depend upon the load-factor.

* * *

Proposed Municipal Plant for Toledo, Ohio.—Councilman John B. Merrill, chairman of the street-railway committee of the City Council at Toledo, Ohio, has announced that as soon as the new councilmen take their seats he will introduce legislation providing for the establishment of a municipal lighting plant in that city. He has arrived at this decision, he says, because the Toledo Railways & Light Company is contesting the ordinance providing for a rate of 8 cents per kw-hour, with a discount of 1 cent. Mr. Merrill has stated that he believes the city can operate a plant that will furnish energy to the small consumer at 5 cents per kw-hour and to the manufacturer at 2 cents, and he cites the plants at Columbus, Ohio, and Pasadena, Cal., as examples of what can be done. Should this legislation be introduced it will probably have to be put to a referendum vote in the fall of 1912, in case such a vote is demanded. Mr. Merrill believes that a plant to cost half a million dollars will serve the purpose and that it can be operated in connection with the water-works system. City Solicitor Schreiber stated that a bond issue can be voted upon at a special election.

* * *

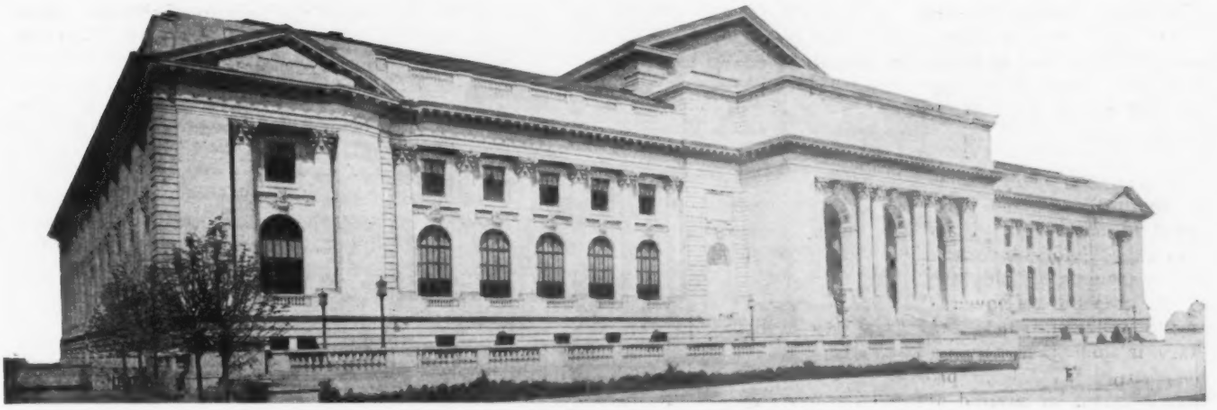
Cathode-Ray Telephotograph.—In his presidential address before the Röntgen Society Mr. A. A. Campbell Swinton described the operation of a proposed arrangement for transmitting pictures electrically. Both the transmitting and the receiving apparatus would consist of a cathode-ray tube, with arrangements for deflecting the ray through ten vibrations per second in a vertical direction and 1000 vibrations per second in a horizontal direction. In each case the ray plays over a screen divided into a large number of separate parts. At the transmitting station the ray would receive charges varying according to the luminosity of the parts of the screen over which it played, each part being active photo-electrically. The charges passing to the line wire affect the cathode ray at the receiving station and correspondingly vary the luminosity of the fluorescent screen, over which the ray plays completely ten times per second, in synchronism with the ray at the sending station.

* * *

Patent Office Examiners.—The commissioner of patents, Hon. E. B. Moore, in his annual report just made public, pays a strong tribute to the present force of Patent Office examiners. The examining corps to-day is, he says, made up entirely of men who have been graduated from various technical colleges and schools, and they possess a very thorough foundation of knowledge when they enter the office through the competitive examinations. With but a few exceptions they all take courses at some of the law colleges of Washington which provide night sessions, with the result that in about four years of service they become graduates and are admitted as members of the bar, both in general and in patent law. The commissioner regrets, however, that, although the salaries have been materially increased in the past three years, he has been unable to hold as great a percentage of this specially trained class of men as is desirable to obtain the best possible aggregate efficiency. There is still a certain percentage that separates from the service after a comparatively short period—generally when they have become most valuable. This is on account of the low salaries as compared with the inducements offered by the large corporations and established law firms.

* * *

The Captain John Ericsson Memorial Society of Swedish Engineers.—In 1907 a score of Swedish engineers founded a society called the Captain John Ericsson Memorial Society of Swedish Engineers. The object of the society as stated in its constitution is to honor the memory of John Ericsson, and to maintain and promote the good reputation of Swedish engineers. The society, which now has about 150 members, is actively engaged in collecting articles of all kinds which in any way relate to John Ericsson's work. Much interest in its work has been shown, and valuable assistance has been rendered by American engineers. Realizing the importance and the desirability of closer connections with the American engineers, the society at a recent meeting established a new class of members called associates who may be engineers of any nationality. At the same meeting it was decided that the society shall have a monthly dinner at which a lecture shall be delivered or other intellectual entertainment provided. The desire of the society is to stimulate interest in its work and bring together the Swedish and American engineers socially and professionally and to work with united forces not only to honor the memory of a great Swedish-American, but also to pave the road for the younger set of Swedish engineers coming to this country. Mr. C. G. de Laval, Harrison, N. J., is president and Mr. G. Tisell, 239 West Thirty-ninth Street, New York, is secretary of the society.



THE NEW YORK PUBLIC LIBRARY.

Its Electrical Equipment, System of Distribution, Means of Control and Method of Illumination.

A 250-Volt, Two-Wire, Direct-Current System Adopted Because of Large Motor Load and Great Length of Feeders—Lamp Circuits Equipped for Divided, Multiple and Remote Control—Extensive Low-Potential System.

By Eugene E. Smith.

LOCATED at the Fifth Avenue end of Bryant Park, and extending from Fortieth to Forty-second Street, is the New York Public Library. The edifice, which was begun in 1897 and opened this year, is one of the finest in the world, and its architectural treatment within and without accords fully with the uses to which such a structure is put. Within its marble walls are housed the Astor, Lenox and Tilden Foundations, and room is provided for from 1,500,000 to 2,500,000 volumes. The main reading-room has seats for 768 readers, and in the entire building 1760 can be accommodated at one time. The stack-room has 334,000 running feet of shelving, while other special rooms provide 70,000 additional running feet of shelving. The building is lighted, heated and ventilated from a central generating plant located in the basement on the Fortieth Street side, and the features of this installation and also of the electrical equipment throughout the building are described in what follows.

GENERATING EQUIPMENT.

The installation comprises eight 217-hp Babcock & Wilcox boilers, two 200-kw, four-valve, non-condensing, single-cylinder, horizontal Fitchburg engines, and two 500-kw Fitchburg engines, each driving a two-wire, 250-volt, compound-wound Westinghouse generator. The sets are mounted on solid foundations of concrete set on a bed of sand, with a cushion of sand on all sides so as to prevent the vibration and noise under operation from traveling through the steel and masonry work of the building. The engines and generators are painted gray with a bluish stripe and varnished, and all other machinery has been finished to correspond. The conduits for the leads from the generators to the switchboard were installed in the engine and generator foundations, and terminate in an iron box at the generator end and at the switchboard end. The leads consist of stranded cable, extra flexible, and for the 500-kw generators each comprises four 700,000-circ. mil cables. Each lead from the 200-kw generators consists of two 600,000-circ. mil cables. These cables and the rheostat wires are rubber-insulated and lead-covered. For emergency and night loads a storage-battery plant has been installed, comprising 141 Electric Storage Battery Company's cells, thirty-four of which are end cells. All battery connections are made with lead-covered copper bars, which encircle the battery-rooms at a height of 7½ ft. above the floor. The bars are carried on porcelain insulators attached to iron hangers supported from channel irons. The hangers are suspended from the channel irons by bolts having insulating joints between the bolts and the hangers.

The switchboard is located in the center of the generator-room against the north wall. It contains the usual instruments, circuit-breakers, etc., in addition to watt-hour meters, graphic voltmeters and ammeters. The feeders are located on panels adjoining the generator section of the main switchboard. The switches are arranged according to size, the largest being at the bottom of the panels and the smallest at the top. The separate panel arrangement for lamp and motor circuits is due to the desire to meter the energy passing over each, and results in a simplified busbar arrangement on the rear of the board. The switches, which are set horizontally, are arranged so that the fuses are dead when the switch is open. At each switch is a name plate, and under each set of fuses on the face of the panel is a removable strip of marble, which can be taken out and cleaned should it be marred by the blowing of a fuse. The generator panels are 3 in. thick, while the other panels are 2 in. thick, and all are of white Italian marble. Above the switchboard, to a height of 4 ft., is a box inclosed on the front and sides with polished white marble for feeders. All connections on the rear of the switchboard running to switches are made with copper bars, and those running to instruments with asbestos-covered wire. The busbars are designed to carry 800 amp per square inch. In order to obviate the presence of cable behind the board copper rods have been installed from the lugs on the switches to the top of the board, where they are held in place by a perforated slate slab. The rods are covered with circular loom and have connectors fitted at the upper ends for the feeder cables. Inasmuch as the busbars and other connections necessitated these rods to be run at approximately 15 in. from the rear of the board, fiber braces are employed to hold them rigidly in place.

DISTRIBUTION SYSTEM.

Starting at the switchboard, an extensive conduit system runs through pull boxes to distribution boxes, to motors, outlets, etc. Black loricated conduit has been employed throughout the building except in the stack-rooms, where galvanized conduit is used. With the exception of the conduit in the stack-rooms, the conduit for lighting system in no place is smaller than ¾ in. The conduit work in the stack-rooms is exposed and is run through the angle-iron frames holding the stacks. A complete description of

this equipment and of the lighting of the stack-rooms was published in the *Electrical World*, Oct. 17, 1908.

Pull boxes are installed in accessible places, so as to make the installation of feeders easy. A rack made up of porcelain rollers is installed in the box above the switchboard, and the feeder cables run on these rollers to a point over their respective lugs. From the box the feeder conduits run to a large pull box on the ceiling of the pump-room, whence the feeders are routed to the distribution boxes, etc. The conduits are installed so that all circuits are drawn in on the loop system. At each outlet for ceiling fixtures, wall fixtures, push switch, base receptacles and floor receptacles are special iron boxes, enameled both inside and outside. Ten riser points centrally located for bronze face plates, and the floor outlets are of the Fountain waterproof type.

The distribution boxes are of sheet steel, and each contains a switch panel and an interconnection panel, with gutter space on all sides for feeders and branch circuit wires. A panel of 1-in. marbleized slate is installed in each box, and on it are mounted the knife switches, automatic switches and busbars for lamp and motor circuits. The branch circuits are controlled by double-pole knife switches equipped with link fuses, and the remote-control switches throughout the installation are of the Pettingell-Andrews type. The busbars are arranged so that the feeders connect at one end and feed from the other end. The lamp circuits are controlled by knife switches located in the same posi-

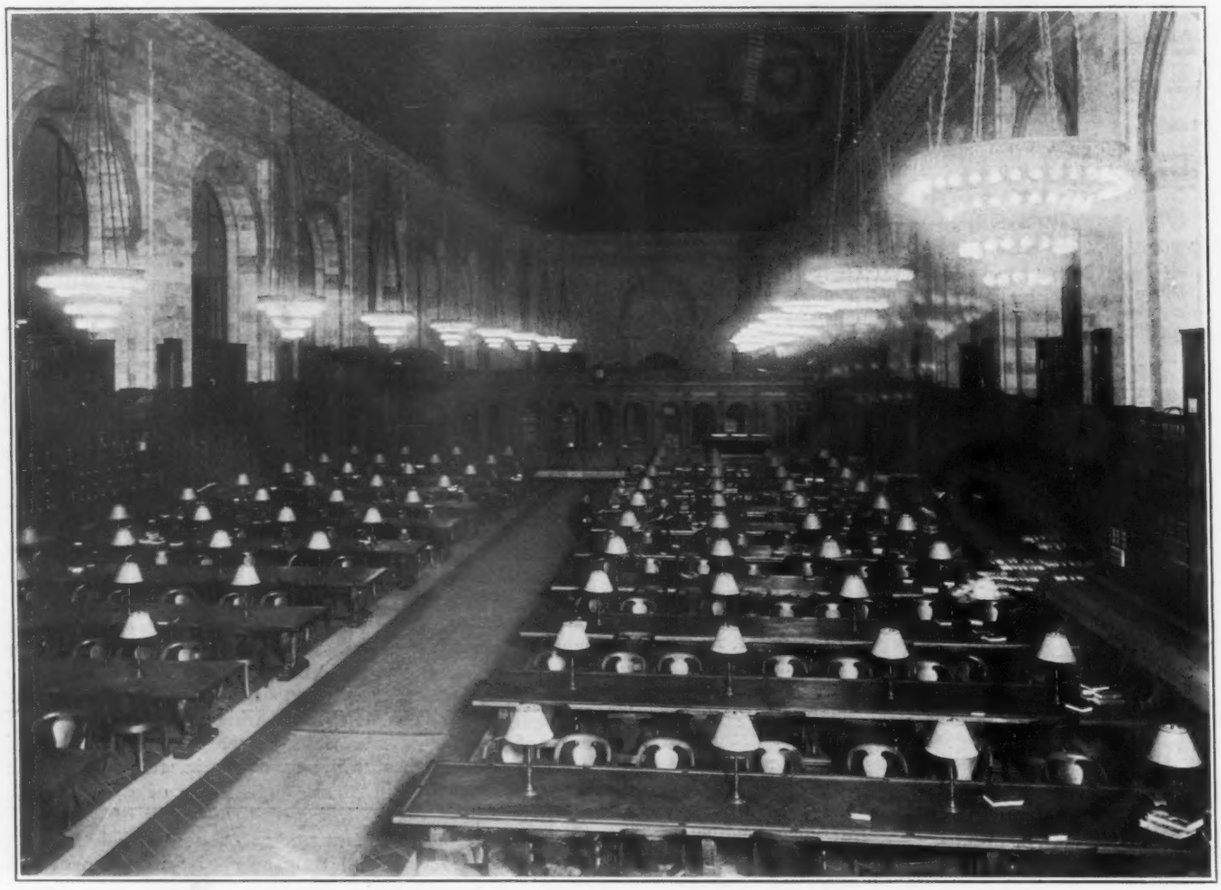


Fig. 1—Main Reading Room, New York Public Library.

the leads they feed are used, and the circuits are run up these riser shafts and connected to the lighting panels. From these panels sub-feeders are run to panels in rooms that require individual control of the lamps and motors.

The feeder system is divided into sections, so that the engineer can at certain times, day or night, know where lamps and motors are needed, and thus have control of the load. The main switchboard being located at the Fortieth Street side of the building and some of the riser shafts at the Forty-second Street side, with distribution panels on the top floors, the runs to the latter are exceptionally long. The circuits are designed so that the drop between the switchboard and any lamp or motor is not greater than 5 per cent, while the difference of potential between any two lamps is not more than 2 volts. The local switches used throughout the structure are of the Diamond H type, and double-pole, three-way and four-way switches, with lock and remote control, are used extensively. Bronze plates are fitted to all local switches. The base receptacles are also of the Diamond H type, with

tion on all panels, and the switches are equipped with white handles, so that they can be readily distinguished from the other switches. Each panel is provided with a goose-neck and lamp-key socket.

The directories on each panel are made up in the form of a small plan of the section of the building in which the panel is located, and the outlets are marked and numbered to correspond to the number of the switch controlling them. The doors and trim of all the panels are made of cast bronze.

ILLUMINATION.

In the engine-room the lighting fixtures are arranged around the skylight in the ceiling and comprise clusters with white porcelain reflectors. Wall fixtures and base receptacles are also installed for working purposes, and on the top of each generator field frame is a 12-lamp standard with white porcelain reflectors. The latter fixtures are individually controlled from the generator section of the main switchboard by knife switches. The conduits carrying the wire to these fixtures are run on the inside of the

field frame. In the pump-room general illumination is provided by ceiling fixtures, and for working purposes base receptacles have been installed in the locations. Outlets in the boiler-room are placed so as to light the gages and water columns, and wall receptacles are provided for working purposes, with wall brackets and receptacles in the aisles back of the boilers. In the ash pit, coal-rooms, feeder runway, locker and wash-rooms general illumination is secured from outlets controlled from distribution panels located in the boiler-room and locker-room. Throughout the sub-basement drop lamps are provided, and in rooms where machinery is located wall receptacles have been installed for working purposes. In those portions of the basement which are used for working purposes general illumination is obtained from ceiling fixtures, controlled by push switches located at the entrances to the respective rooms. In the printing and bookbinding departments, in addition to the general illumination, drop lamps have been installed over the workbenches and machinery. The panels controlling lamp and motor circuits in these departments are located so as to give the workmen immediate control of the circuits.

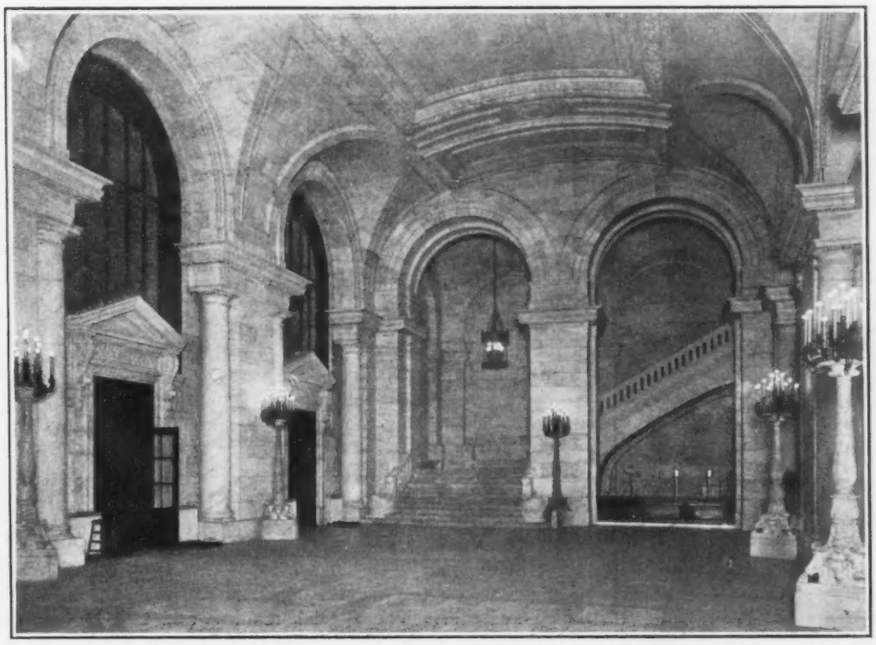


Fig. 2—Main Entrance Hall, New York Public Library.

In rooms containing desks placed some distance from the walls provision is made for feeding energy to the lamps through extensions from waterproof outlets in the floor, which connect to receptacles at the back of the desks. For these receptacles extensions are made with reinforced silk cord to portable lamps. In the room set aside as a lunch-room provision has been made for electric heating by the installation of receptacles for that purpose. In the lending and delivery-room illumination is obtained from ceiling outlets arranged in the ornaments of the ceiling around the skylight. These fixtures are so wired that the switches controlling the circuits are arranged in sections, each of which is connected to an automatic switch on the distribution panel. The automatic switches are controlled from a point in the main desk by means of push switches. The ceiling lamps are divided into two sections, and one section contains one-third and the other two-thirds of the lamps. In addition to this general illumination, provision has been made in the floor for extensions to desks for working lamps. The panels that control the latter are located in passages immediately below the room.

The corridors are illuminated by means of ceiling fixtures located at proper distance from each other and so arranged that there are no parts of the corridors not properly illuminated. The lamps in the corridors are controlled by knife switches. On the first floor are rooms used for special purposes, such as reading-rooms, stack-rooms and exhibition-rooms. The general illumination is provided from electroliers hanging from the ceiling, supplemented by desk lamps fed from floor outlets. In the special stack-rooms the lighting

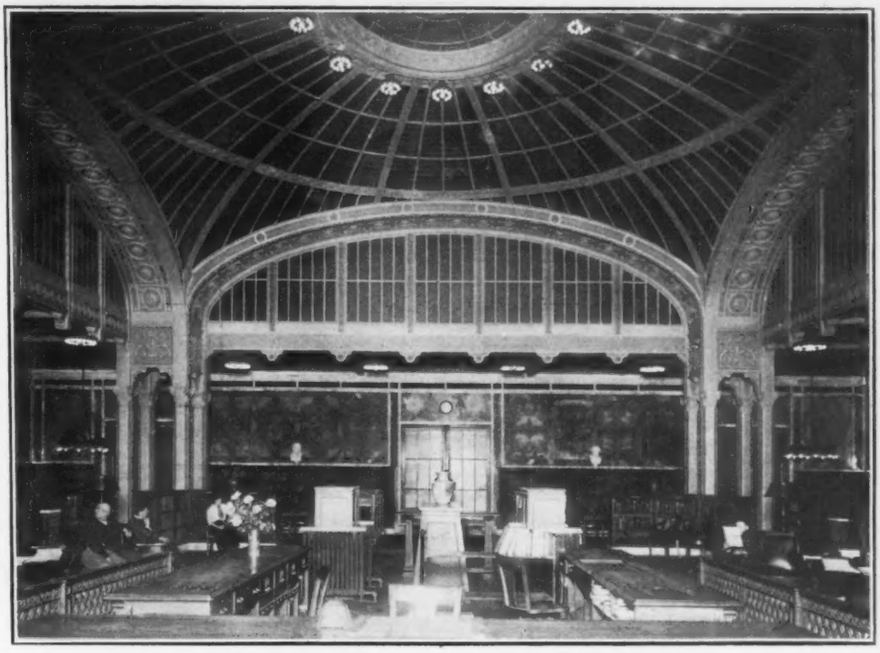


Fig. 3—Circulation Room in Basement.

arrangements are similar to those in the large stack-rooms; that is, all the conduit and outlets are exposed on the bottom of the stack frame and in the aisles, and where there is no frame the conduit is held in place by stands fastened to the

tops of the stacks. The outlets in the stack aisles are controlled by automatic switches, operated from push switches set in the ends of the stacks.

The entrance hall on the Fifth Avenue side is lighted by standards of artistic design. The circuits are controlled by automatic switches operated by push switches located in

Fig. 4—Exhibition Room on Main Floor.

the base of the standards. Although the ceiling of the hall is on a level with the ceiling of the second floor, the illumination obtained from these standards is sufficient, the walls and ceiling being of white marble. From the foot of the stairs leading to the second floor are large fixtures of beautiful design, fed from automatically controlled circuits operated by push switches in the main hall. The exhibition-rooms are provided with ceiling fixtures, also supplied with energy through automatic switches, operated by push switches located at the entrances to the rooms. In some of the special reading-rooms on this floor stacks are arranged along the side walls and balconies over them, so that special provision had to be made for lighting the stacks.

The conduit is also exposed on the bottom of the framework of the balcony, and special outlet boxes equipped with reflector fixtures are inserted where necessary. Each fixture has two tubular lamps connected in series.

In the lecture-rooms the general illumination is obtained from ceiling fixtures. In addition, provision is made so that a reflector can be installed to illuminate a screen or chart at the lecturer's desk. A special flash-signal arrangement is provided from the desk to the location of the lantern operator. Arranged in the corridor overlooking the Fifth Avenue hall and located so as to give the best results are standards of pleasing design in addition to ceiling outlets. A number of special reading-rooms are provided for works in foreign and ancient languages, and in addition to the general illumination of these rooms standards are placed on the reading tables, fed from floor outlets through flexible conduit concealed in the furniture.

On the third floor are located the main reading-room, special reading and stack-rooms, catalog-room and art galleries. The main reading-room is located on the west side of the building. The fixtures for this room are suspended from the ceiling, and are of such size that a distribution panel has been placed in the attic space above the ceiling for each fixture. On these panels are mounted two automatic switches, so connected that one controls the section that feeds the upper lamps and the other controls the section feeding the lower lamps of the fixture. The control switches are arranged in a bank in the working space in the center of the reading-room. The fixtures are re-lamped by lowering them to the floor, and because of this the connections are made from the distribution panel to a gang of wall receptacles installed on the walkway immediately above each fixture. The connections from the fixture are made by inserting the plugs attached to the fixture wires into receptacles provided for this purpose. The wires from the fixture to the plugs are bunched and covered with a flexible tube.

Arranged around the entire reading-room are book-stacks illuminated by means of Frink stack reflectors fitted with tubular lamps. The circuits are controlled from the working section of the reading-room by means of push switches located in the bank of remote-control switches. The tables in the reading-room are provided with standards connected to waterproof floor outlets, and the lamps are controlled by knife switches on the distribution panels on the seventh stack floor below the main reading-room. The cables that feed the panels for the individual ceiling fixtures in the reading-room are controlled from the distribution panels on the seventh stack floor by means of large knife switches. The special reading and stack-rooms on this floor are equipped with lighting fixtures, for both reading and working purposes, of the same kind as those used in other rooms of the same character on other floors.

In the catalog-room, which is located in the center of the building, the lighting arrangement is almost the same as that used in the main reading-room. The art galleries

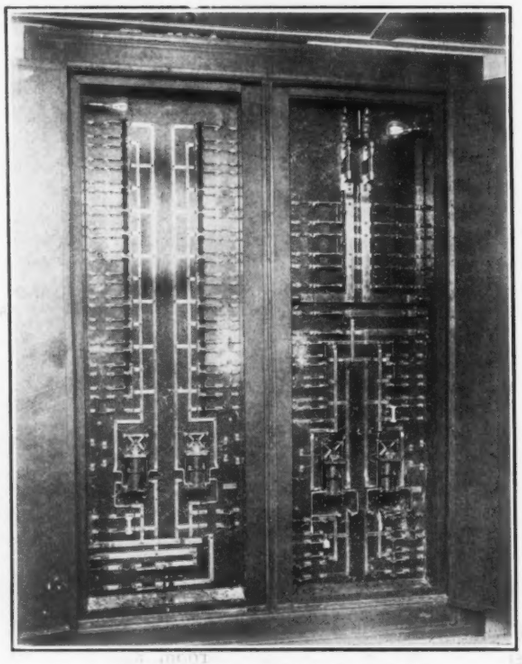


Fig. 5—Typical Distribution Panel.

are fitted up with ceiling fixtures for general illumination, and about 1000 ft. of special cold-drawn bronze Frink reflector is used to light the pictures. Waterproof outlets have been provided in the floors of the art gallery, so that future arrangements may be taken care of. The attic space, in which are located the exhaust fans, ducts, tanks

and distribution panels, is provided with an iron walkway, and to give proper illumination drop lamps are provided. Inasmuch as the space can be entered from two points, the lamps are arranged to be controlled from either entrance by three-way switches.

Throughout the building certain lamps on certain fixtures are independently wired and controlled and fed from special feeders. These lamps are for the use of the watchmen, and are so circuited that the engineer can pull all the switches on the main switchboard except the ones controlling these feeders. Many of the rooms of the building have more than one entrance, and the lamp circuits are therefore operated by three-way or four-way switches. The walkway surrounding the library and also the court are illuminated from lamp-posts of special design. Manholes are provided in the lawns, in each of which is a distribution panel controlling the lamps in the posts.

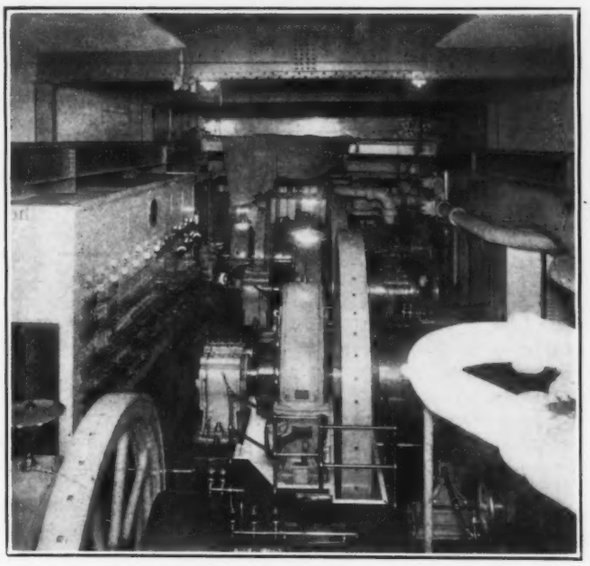


Fig. 6—Generating Plant, New York Public Library.

MOTOR EQUIPMENT

There is a completely equipped machine shop, fitted with electrically driven tools, in addition to a print shop and bindery. The printing shop and bindery are capable of doing the printing and other work necessary for the different departments of the library. The printing of the catalog alone will keep the machinery working for a number of years before it is finally completed. The presses and other apparatus are all electrically operated. The motor installation aggregates about 500 hp. Because of this load, and also because of the long run of some of the feeders, a 250-volt system was chosen.

BOOK CONVEYORS.

In addition to an extensive motor-driven ventilating system, there is a motor-driven elevator system, comprising two passenger elevators, a freight elevator, a sidewalk lift, an ash and coal conveyor, eleven automatic book lifts and two book conveyors. The book lifts are located in different departments of the library, and some are capable of being called and of being sent to any landing, and others are capable of being called and sent to only one point. There are six lifts in the main reading-room and main stack floors, one at each end and four in the center, and these are connected so that the cars can be called from the main reading-room and sent to any stack floor, but the attendant on any of the stack floors can only call the cars and send them to the main reading-room. In connection with this system there is a buzzer arrangement, which operates momentarily when the cars leave the floor and constantly until the door is opened at the floor to which the car is sent. At the four-car installation in the center of the main reading-room and stack floors there is at the main reading-room level an operator's station, so arranged that the operator can assume control of all four cars. By thus centralizing control unnecessary trips are prevented. At the operator's desk there is a set of lamp indicators, showing the location of each of the four cars. Lamp indicators are also located over the door of each shaft at the main reading-room level. There is also at the operator's station a lamp indicator to show when a car is wanted at any of the stack floors. All of the lifts are capable of carrying 250 lb. at a speed of 150 ft. a minute.

The electrically operated book conveyors are located on the second floor. One is arranged to carry books and baskets in a horizontal position from rooms in the northeast corner of the building to the northwest corner of the building, and the other is arranged to run from a room in the northwest corner of the building to the center of the stack-room on the sixth stack-floor level. In addition, there is a pneumatic tube system, with stations in rooms in different parts of the building, for conveying written requests, receipts for books, etc.

LOW-POTENTIAL CIRCUITS.

Eight separate intercommunicating telephone systems are installed in connection with the power-plant department, the lift equipment and between departments. In addition, there are a number of bell and annunciator systems. A closing-down system is installed, arranged to be operated from the working desk in the main reading-room, various gongs being sounded throughout the building. The main reading-room also possesses an indicator system with annunciator drops, one annunciator facing north and the other passing south. The annunciators are made up of a box containing small lamps, with a numbered glass in front of each lamp.

The wires used for these various low-potential circuits, as well as for the time service and watchmen's supervisory system, are installed in a separate conduit system. Interconnection boxes are located in distribution panels above the lighting panels at central points of the low-potential systems. The energy for the low-potential system is obtained from batteries and motor-generators. A separate low-potential switchboard is provided in the engine-room.

The building and grounds were designed and the construction supervised by Carrère & Hastings; Pattison Brothers were the consulting engineers; the Lord Electric Company was the contractor for the electrical installation, and the Tucker Electric Construction Company was the contractor for the electrical equipment installed in the furniture.

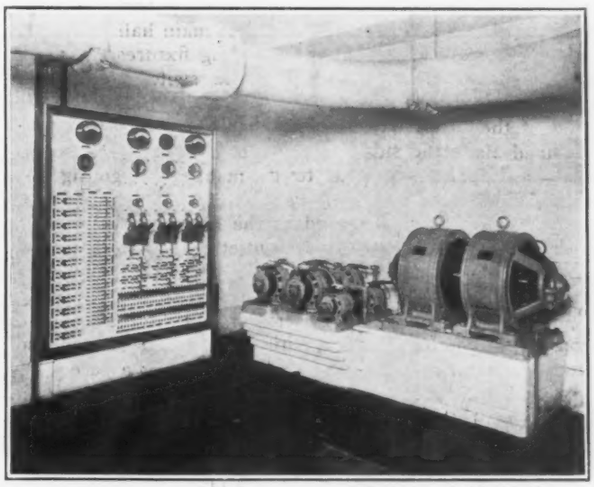


Fig. 7—Low-Potential Generators and Control Board.

AN OIL-ENGINE CENTRAL STATION.

Details of Unit Costs, Repairs, Etc., of 755-hp Plant in Operation Six Years—A Small-Town System with a 41 per Cent Daily Load Factor, Operating Local Industries and City Water Pumping —750 Customers Among 5500 Population.

LEBANON, Ind., has one of the few central stations in the Middle Western States equipped with self-igniting oil engines of the Diesel type. These units have been in service more than six years, affording an excellent opportunity for examining their performance with respect to sustained fuel efficiency, as well as the items of their repair and maintenance over such a term of years. The local central-station situation is also of interest on account of the successful work that has been done in acquiring a motor load, most of the local industries and the city water-works pumping station being operated from the lines of the Diesel-engine plant, resulting in the excellent load-curve shown herewith.

The principal equipment of the Lebanon station comprises two 225-hp, 164-r.p.m., three-cylinder American Diesel engines, direct-connected to 160-kva, 2300-volt, 60-cycle, three-phase alternators, and a 125-hp, 83-kva, 225-r.p.m. unit of similar type. The last of the larger units was installed in 1907, the other two engines having been in service since 1905. Each set is arranged with its own belt-driven exciter, and one engine can also be belted to an air compressor in the main engine-room; but the compressed air for the plant is principally supplied by two motor-driven compressors in an adjoining room. At the rear of the plant building is the cooling tower for reducing the temperature of the engine-jacket water.

The fuel used in the engines is a partly refined heavy oil, testing 30 deg. Baumé and containing about 19,000 lb. Fahr. heat units per pound. From it the sulphur and other objectionable materials have been removed. This oil costs 2.75 cents per gallon delivered in tank cars to the 11,000-gal. underground storage container, 30 ft. south of the plant. The engines derive their immediate fuel supply from two 30-gal. steel tanks within the station, into which the oil is pumped by hand from the underground reservoir once every hour. Each time the levels in the tanks are thus

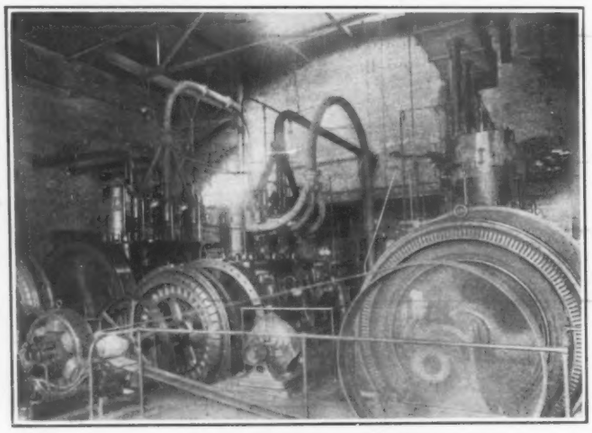


Fig. 1—Interior of Lebanon Plant, Showing 225-hp and 125-hp Diesel Oil Engine.

restored to their normal heights record is made, on a blank form kept for the purpose, of the quantity pumped in, so that the figures thus obtained represent the hourly fuel-oil consumption of the engines. To one unaccustomed to the remarkable efficiencies of Diesel-engine operation the small size of the fuel-oil tanks and pipes in the station will occasion some surprise. The quantities of oil fed to the engines are, however, exceedingly small, averaging less than half a thimbleful per cylinder per stroke in the case of the 225-hp units. Under ordinary conditions the engines consume from 10 gal. to 20 gal. of oil per hour and produce 10 kw-hours per gallon of oil.

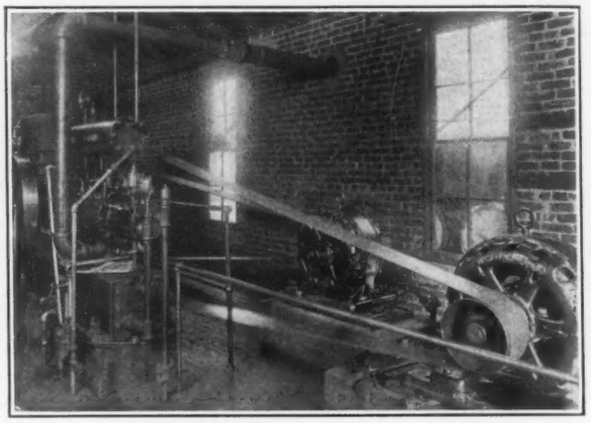


Fig. 2—Motor-Driven Air Compressor Delivering Air at a Pressure of 65 Atmospheres.

Compressed air for the fuel jets, at a density of about 65 atmospheres or nearly 1000 lb. per square inch, is supplied by two three-stage water-cooled compressors, one of the horizontal-tandem Ingersoll-Rand type and the other a vertical machine built by the American Diesel Engine Company, each compressor being separately belt-driven by a 30-hp, three-phase Westinghouse induction motor. A similar vertical compressor is arranged to be belt-driven directly from the shaft of one of the large engines. Connected to the high-pressure air line are a number of steel "bottles," or high-pressure containers, in which compressed air is held over for starting up the engines.

The free air for the engines is taken in through large pipes opening into the outside atmosphere in the case of the two earlier units, while the latest engine receives its air directly from the engine-room through the boxlike arrangement shown at the right of Fig. 1. As is well known, the Diesel engine operates on the four-cycle principle, every second revolution being a power stroke. On the compression stroke free air is taken into the cylinder and compressed ahead of the piston to a pressure of more than 500 lb. per square inch, raising it virtually to a red heat by the end of the stroke. At this instant the fuel oil is sprayed into the highly heated and compressed cylinder contents by the higher air pressure from the compressor lines. As the fuel spray enters the cylinder it is ignited by the high temperature met with and burns in a steady, not explosive, flame during the fraction of a second that admission lasts. The fuel supply is cut off after about one-tenth of the expansion stroke has been traversed, and from this point expansion proceeds adiabatically.

The cylinder jackets and valves are prevented from overheating by circulating through them water that has been cooled by trickling over the cooling tower just behind the station. This tower, as shown in Fig. 3, is 10 ft. by 5 ft. in plan and 10 ft. high, containing nine trays made up of wooden slats over which the water drips from the rows of perforated pipes overhead. Owing to the very high thermal efficiency of the Diesel engines and consequent small waste of sensible heat the quantity of water circulated is very much less than for an equivalent rating of gas engines. The water leaving the jackets is usually at a temperature of from 110 to 120 deg. Fahr., and during its passage through the overhead tank and cooling tower is lowered to about 80 deg. As a result of the low humidity which exists during part of the summer in this section of Indiana the

water coming from the tower is often reduced several degrees below the temperature of the atmosphere itself. From the cooling tower the water is caught in the concrete basin at its base, shown in Fig. 3, and thence is circulated directly through the engine jackets to the overhead tank, where it also undergoes a few degrees of cooling before passing to

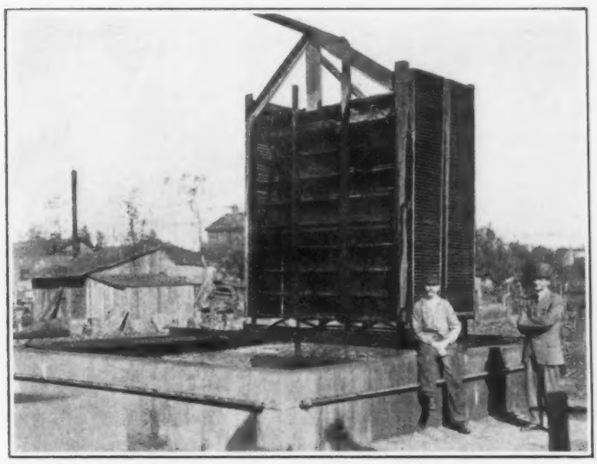


Fig. 3—Cooling Tower for Diesel Engine Jacket Water.

the spray. A 2-hp motor-driven centrifugal pump performs the work of circulating this jacket water, while another motor-driven well pump keeps the level in the storage tank constant. Part of the jacket water coming from over the exhaust chamber is collected and filtered in the station and is then pumped to a nearby railroad watering tank for use in locomotives. The income derived from this source thus helps to reduce the operating cost of the station, and the waste heat in the water aids in keeping the tank from freezing.

All three of the engine-driven alternators are operated in parallel on a common 2300-volt bus, from which the various services are in turn taken off. Under the former plan of running the station the engines were run as separate systems, but by a change of wiring it has been possible to synchronize all apparatus without difficulty, securing the advantage of division of load between the various units. A resulting peculiar feature of the Lebanon plant is the exchange of relatively large cross-currents between the several alternators, these exchange currents often representing a value of as high as 25 per cent of the main current at the time of full load. The ammeters indicate that this pulsation occurs with a frequency of from 15 to 30 times per minute, but through the excellent field regulation imposed by a Tirrill regulator this variation is barely capable of being noticed on the bus beyond the separate machine leads.

The cost of producing a kilowatt-hour in the Lebanon plant has averaged 2.8 mills for fuel oil alone and 1.9 mills for labor. Three men are employed about the station, but one of them gives only half of his time to the operation of the plant, having also charge of making arc-lamp renewals, overhead repairs, etc. Lubricating oil and waste have averaged 0.2 mill per kilowatt-hour. The item of repairs on this plant has been rather heavy, although difficult to ascertain with accuracy. During four years prior to the time the present management took charge the renewal parts included fifteen cylinder heads, one crankshaft and two cylinders. This high fatality among the cylinder heads was afterward traced to the lack of adequate cooling by the circulating water. Thermometers have now been placed on all outlets, and these readings are carefully noted at frequent intervals, so that the temperature of no outlet water at any time rises beyond 120 deg. Fahr. Such a minor injury as a cracked cylinder does not necessarily impair the operation of an engine. One of the Diesel units at Lebanon has been running with a very small crack in the cylinder for several months, with no other evidence of its deficiency than a slight noise and a cloud of steam in the exhaust at each discharge from this cylinder. At all other times the exhaust gases are quite invisible, except when starting on very rich charges. During the year that the plant has been in the hands of its present management the repair items have been slight, as the result of the careful attention given the discharge water, although the cylinder just mentioned cracked without apparent cause and has not as yet been replaced.

The Lebanon plant enjoys an excellent load factor, its total output averaging about 41 per cent of the twenty-four-hour equivalent of its maximum demand. During the eight hours of the working day its load due to motors averages 78 per cent of its evening peak. Among the profitable motor services supplied by this station are the city water-works pumping plant, whose 60-hp load occurs eighteen hours daily during off-peak periods; a 25-hp planing mill, a 50-hp flour mill and 60 hp in motors in a cream separator factory. There is a total of 518 hp connected in three-phase motors. The rate for this motor service varies from 5 cents to 2½ cents per kw-hour, according to the quantity that the consumer may use.

Altogether the Citizens' Electric Light & Power Company, of Lebanon, has 750 customers, which in its little city of 5500 inhabitants gives one consumer to every seven people. The rates charged for lighting service are 10 cents per kw-hour to residences and 8 cents per kw-hour to stores and other commercial establishments. These rates are net, and in case of unpaid bills are subject to 10 per cent increase after the tenth of the month. The central-station

CENTRAL-STATION CUSTOMERS FOR MONTH OF SEPTEMBER.

Year.	Metered.	Flat-Rate.	Total.
1910	476	159	635
1911	631	119	750

income per inhabitant at Lebanon is $6.20. The accompanying table shows the number of flat-rate and metered customers receiving service from the company as of date Oct. 1, 1910 and 1911.

The gross receipts for the same period of September, 1910, were $2,534.53, and for September, 1911, $2,786.98. These returns indicate that during this year about forty of the most determined flat-rate customers were converted to service on a meter basis.

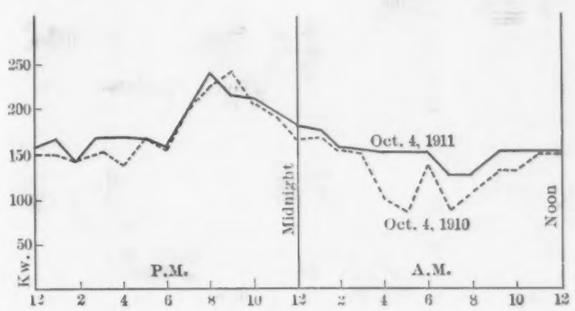


Fig. 4—Daily Load Curve of Diesel Engine Station, Lebanon, Ind.

Mr. C. E. Layton is secretary, treasurer and manager of the Citizens' Electric Light & Power Company, which operates the Diesel plant at Lebanon. Mr. T. C. McReynolds, of Kokomo, Ind., is president, and Mr. T. A. Scott is vice-president. The superintendent and chief engineer of the station is Mr. B. F. Jones.

MINIATURE HYDROELECTRIC PLANT AT SPRINGFIELD, VT.

Description of Reinforced-Concrete Dam, Power House with Impulse Wheel Operating Under 80-Ft. Head, and Circuit Arrangements for a Private Mountain Camp.

By M. A. Hicks.

FEW private fish and game preserves combine so much of the wildness and seclusion of a mountain glen with all the comforts and conveniences of modern life as does that known as "Muckross," owned by Mr. W. D. Woolson, of Springfield, Vt.

This preserve covers an area of 600 acres of mountainous land bordering Black River on the north and is well stocked with game native to the region. The approach over a steel suspension bridge at a height of about 25 ft. above the river and through a rustic anteroom, the door of which is guarded by an electric lock controlled from the distant bungalow, reminds one of some ancient castle with its moat and drawbridge and serves the purpose of keeping out undesired visitors.

This bridge with its anteroom located close beside the track of the Springfield Electric Railroad, and also the winding path beyond which leads to the bungalow in the glen, are all brilliantly lighted at night by incandescent electric lamps. All lamps exposed to the weather are mounted in special weatherproof fixtures designed for the purpose by Mr. J. Gardner Menut, the electrical contractor who installed them. These fixtures consist of 6-in. clear glass globes open at the bottom and mounted over 25-watt tungsten lamps. Porcelain weatherproof sockets are used and the fixture is mounted at the top of ¾-in. "galvaduct" piping, no ornamental posts being employed.

The service wires feeding these lamps are carried in ¾-in. "galvaduct" underground conduit, to which the vertical pipes are connected through 4-in. marine-type junction boxes having four outlets. The boxes are placed edgewise with one outlet for the lamp pipe at the top and the bottom one, having a 2-ft. length of pipe, closed at the lower end and driven below the bottom of the trench to act as a support to brace the pipe and fixture. The ¾-in. conduit carries four wires, two feeder and two switch wires, by which three-way switches at both the bungalow and anteroom control the lamps.

A telephone outside the anteroom enables visitors to

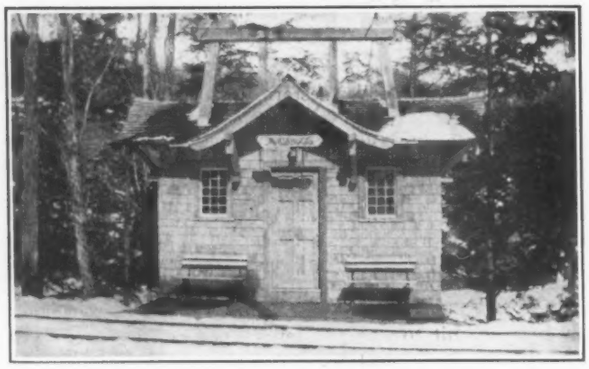


Fig. 1—Exterior View of Miniature Plant.

announce their presence, and if welcome the door is opened for them by the same mysterious agency that conveyed news of their arrival. As they step inside a signal bell announces the fact to their distant host at the bungalow, where all kinds of electrical service, including lighting, heating, cooking, sweeping, ventilating, etc., are employed.

Excepting for the telephone and signaling service, which requires ordinary dry-cell batteries, the source of electric energy is a small spring-fed trout brook having an estimated average flow of 16 cu. ft. per minute, though sometimes dry in parts of its course and subject to floods of from fifty to sixty times the average flow. This little

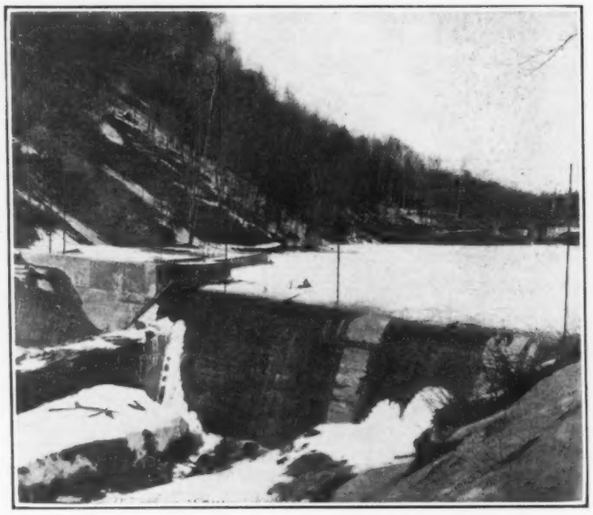


Fig. 2—View of New Reservoir.

stream passes in a narrow, deep valley in a north to south direction through the preserve, and 500 ft. from its entrance into Black River falls over a nearly vertical ledge a distance of about 60 ft. Back of the falls there are rapids and a small gorge in the bedrock which formerly drained a long, narrow and swampy meadow that extended nearly half a mile upstream.

By means of a reinforced-concrete dam this meadow has been converted into a sixteen-acre reservoir with a depth of 12 ft. at the dam, of which 6 ft. may be drawn for power purposes at a small hydroelectric plant located in the glen near the foot of the falls. The dam is the third one built in an attempt to impound the water of the stream at this point. Owing to the treacherous nature of the abutting hillside, which rises about 100 ft. above the dam and is composed of a sticky, clay-like soil or silt, without grit, and which when saturated with water forms a treacherous quicksand, previous dams have failed.

At the eastern end the dam abuts against bedrock and rests upon it to a point about 40 ft. westerly from the spillway.

Messrs. Crosby & Parker, of Brattleboro, Vt., the contractors who built the dam, gave guarantees that it would remain watertight and safely hold for five years, and as the method of overcoming the difficulties met with may be of interest to others it is here given in some detail.

The main dam of reinforced concrete is 8 ft. wide at the base, rises 12 ft. to the spillway, which is 70 ft. long and has an ogee form on the downstream side and a slope or batter of 1 ft. in 10 ft. from the base to the top on the upstream side. It is reinforced with 1-in. twisted steel rods extending lengthwise in a vertical plane, with 1-ft. spacing. Heavy steel dowel pins extend down into bedrock for anchorage.

At the west end of the spillway and rising 3 ft. above it is the forebay, which is, in internal dimensions, 3 ft. wide, 6 ft. long and 9 ft. deep, the floor being raised 6 ft. above the bottom of the reservoir that the trout may always have sufficient water for their needs. A sluice pipe through the base of the dam provides means for draining and cleaning the reservoir if desired.

The top of the opening from the reservoir into the fore-

bay is some 3 ft. below the level of the spillway to the dam and thus prevents floating rubbish from entering, and also providing, when the plank covering is over it, a frost-proof place for the headgate to the penstock and the air pipe with it.

There are three sets of grooves in the sides of the forebay, each 2 in. wide and 1 in. deep, for wooden frame screens with heavy ¼-in. mesh galvanized wire netting. Any one may be removed for cleaning, leaving two in place, or if desired planks may be placed in one set of grooves to shut out the water from the forebay.

Extending from this forebay to the power house there is a 6-in. spiral riveted steel penstock with flanged sections bolted together. It is 380 ft. in length. Beyond the forebay the dam is reduced in thickness at the base to 2½ ft., with an even slope from bottom to top on each side of 1 ft. in 10 ft. and having the same reinforcement of steel rods as the main dam. For a distance of 40 ft. from the spillway this wall rests upon a bed of shale which has an almost vertical dip and a strike of about 42 deg. east of north. This floor of rock has a gradually descending slope for the distance named and then abruptly disappears in a slight overhang from the vertical and ends in a formation of clay and quicksand of unknown depth. An excavation was made beyond bedrock in this formation 10 ft. long, 8 ft. wide and to a depth of 4 ft. below the lip of the bedrock, when the inrush of very cold water and the dangerous nature of the material compelled a stop. A sounding rod 15 ft. long was sunk below this excavation without finding bottom.

To prevent caving of the sides and to confine the quicksand a border of sheet piling of matched spruce was driven around the edges of the pit to a depth of 12 ft.; then the bottom of the area inclosed was studded with piling well driven to place and concrete poured into the mould thus made and allowed to set to form a heavy slab for a foundation. Upon this was erected the extreme western end of the front flank wall of the dam, which is now, one year later, entirely buried by the caving and flowing of the clay-like soil over it from the hillside.

Extending from the northwest corner of the forebay at an angle of 45 deg. to the main dam is a wall of concrete 40 ft. long, 15 ft. high and 2 ft. thick. This wall rests upon bed-

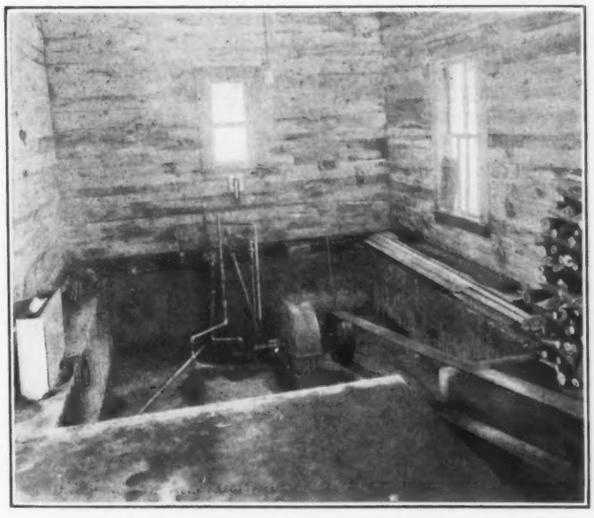


Fig. 3—View Showing Waterwheel Belted to Generator.

rock its whole length, but at its upper end the clay and quicksand formation again appears at a point corresponding to the "strike" of the strata from where bedrock disappears further downstream, as already described. From this point a trench was dug in the quicksand formation parallel to the front flank wall of dam, sheet piling driven as previously described, a concrete foundation made and a wall 35 ft. long, 15 ft. high and 2 ft. thick of concrete was erected. Between these flank or wing walls the space was filled with earth well settled into place, making a water-tight barrier against the lake above.

In clearing the bedrock preparatory to building the dam

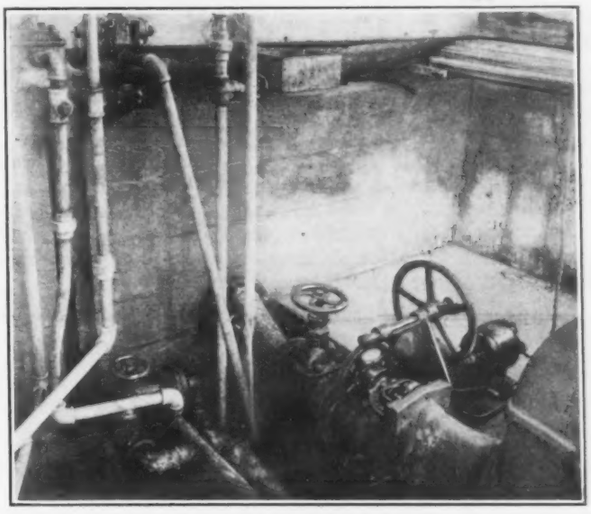


Fig. 4—Motor-Operated Needle Valve.

a small deposit of blue clay was met with. This was carefully saved and found useful when the reservoir first filled, as near the east end of the main dam where the shale rock has been weathered by frost a leak appeared, the water coming up out of the bedrock below the dam like a spring. But the clay tamped into place on the bottom of the reservoir just above that end of the dam entirely stopped it.

The power plant consists of a special 18-in. Pelton wheel using a 1⅛-in. nozzle under a working head of about 80 ft. when the reservoir is full, the static head being about 85½ ft. under same conditions. This wheel has a needle valve for controlling the admission of water to the buckets, and this valve is operated by a reversible electric motor back-geared to a worm and gear through the medium of a friction clutch, the worm gear acting upon a screw having four threads to the inch.

The electric motor takes energy from a storage battery at the bungalow about 200 ft. distant, where a double-throw switch and a small single-pole circuit-breaker control and protect it. The ⅛-hp motor runs at 3400 r.p.m. and it requires two minutes to open or close the waterwheel valve, thus obviating danger from water hammer.

The waterwheel is belted to a 3½-kw, 125-volt, 1300-r.p.m. compound-wound, Western Electric generator, which, however, is used at 112 volts, except when charging the 54-cell "Exide" storage battery. At maximum load there is delivered at the switchboard over a line calculated for 5 per cent loss a current of 25 amp at 112 volts. The normal charging rate of the battery is 3 amp and the regulation as yet is entirely by hand.

The storage battery is designed for emergency lighting and to help out the generator on peak loads. No "reverse-current" or "no-voltage" circuit breaker is used in the charging circuit to battery, dependence being placed upon 4-amp fuses for protection.

A switchboard in the form of a cabinet is located in a bedroom of the bungalow and has ammeters of the Weston type both for reading current of battery on charge and discharge and also generator output. There is also a voltmeter with switches to enable the potential of either the generator or battery as a whole to be ascertained, but there are no means for testing individual cells, that being done in the battery room in the basement.

The number of lamps at first installed for use at the bungalow, garage, stable and power house at the dam was forty-four; six lamps were connected for outdoor use on the suspension bridge and along the paths to the glen; in the anteroom and for a signal beside the railroad at the bridge there were three more. Of these there were forty 25-watt, six 40-watt and four 100-watt tungsten lamps, while two 60-watt carbon lamps were connected on extension cords for garage and battery room use.

Recently a new automobile shelter has been erected across the railway track and highway from the entrance to the suspension bridge, and this is connected to the same lighting circuit through an underground conduit.

All telephone and signaling circuits are carried in an underground lead-covered cable having fourteen wires. These include the local telephone and door lock circuits, public telephone and two buzzer circuits, one to give notice when the anteroom door at the bridge opens and one giving notice of the approach of an electric car when the latter is still a mile distant and two circuits in reserve for emergency use.

In closing it may be said that the region of the Connecticut Valley north from Bellows Falls is very interesting to students of surface geology, and that the location of the little hydroelectric plant above described is found within the terrace formation which extends up-stream from Bellows Falls a long way, marking in the main valley, as well as in valleys of tributary streams, the lines of an ancient glacial lake that became silted up, leaving potholes on Mount Kilburn, opposite Bellows Falls, 800 ft. above the present level of the river, filling ancient river and brook channels, and in many cases causing new channels to be cut through ridges of rock, thus making numerous gorges such as Cavendish Gorge, Queechee Gulf, Devil's Gulch and others, of which the one noted in this article is a sample in miniature. Soundings show that the deep chasm in bedrock now filled with the clay and quicksand formation at Muckross extends past the falls in the stream down to the river and probably under its bed, following the strike of the uptilted strata as if it were a "fault," or softer part, deeply eroded before the coming of the glacial lake. These gorges mark the sites of the best water-powers of the region to-day, but in all cases where a stream has cut itself a gorge the ancient channel, buried under great masses of drift, must be reckoned with in case a reservoir be established back of the rocky hill or ridge.

EFFICIENCY OF "EARTHS" IN RADIOTELEGRAPHY.

Experimental Investigation of the Variation in Efficiency with Size and Position of Earth Wire.

By Charles A. Culver.

THE results of certain preliminary experiments extending over several years led the writer to the conclusion that the disposition of the earth connection in arranging a system for radiating or intercepting electromagnetic waves is of prime importance. These preliminary tests were carried out across both land and water. While the results were not wholly concordant, yet the data appeared to warrant a thorough and systematic investigation of the relative efficiency of various earth connections. It is also hoped that such a study may throw some light on the more or less obscure question of the function of the earth in the propagation of electric waves.

The present investigation has to do with conditions at a radiotelegraph receiving station. A similar study is being made with respect to a transmitting station. The tests were made at the distance of ¾ mile from the 1-kw station at Beloit College, Beloit, Wis. The receiving set was erected in Keep Athletic Field, just out of the city, and consisted of a single vertical wire 50 ft. in length connected to a regular loosely coupled oscillation transformer and perikon detector. The shunted telephone method was used to compare the intercepted energy. This method, though not extremely accurate, was adopted because of its convenience in practical field work. Dependence was placed on the possibility of being able to repeat any given set of results rather than upon highly accurate measurements. The reader who has attempted to make quantitative measurements under practical working conditions will readily appreciate the difficulties encountered and can judge the results accordingly.

The transmitting station is of the ordinary spark type with a wave length of 650 m. The aerial approximates the L type, consisting of two horiozntal wires 275 ft. long supported at a height of 75 ft. at one end and 35 ft. at the other. From the lower end two leads pass to the closely coupled transformer of the transmitting set. This aerial points in the general direction of the receiving station. The transformer is grounded to the city water system.

The soil between the two stations is, for the greater part of the distance, composed of coarse sand. Immediately surrounding the receiving station, which for brevity will be designated as R, the soil consisted of about 2 ft. of black loam covered with grass. Coarse glacial drift underlies the loam. As a standard for comparison an "earth" was established by burying (3 ft. deep) a piece of tin plate having an area of 400 sq. in. The first test consisted in comparing with the above standard "earth" the effect of an "earth" consisting of a piece of tin plate of the same size but laid upon the grass. The receiving system was carefully adjusted to resonance and a series of alternate readings of the intercepted energy was made. The plate laid upon the grass was found to have the same efficiency as the standard "earth."

A piece of galvanized wire netting of ½-in. mesh, having the same area as the standard, was also laid upon the grass and proved to have an efficiency equal to that of the standard.

The sheet of metal and the netting were each in turn insulated from the earth at a height of 7 in. Under these conditions they both showed the same efficiency as the standard "earth."

Following the above comparisons tests were made of the relative efficiency of several forms of "earths" consisting of various lengths of No. 16 copper wire laid loosely upon the grass. The following table embodies a part of the results obtained, S representing the transmitting station:

Direction of Earth-Wire with Respect to S.	Length of Earth-Wire, Feet.	Ratio of Efficiency of "Earth" Tested, to Standard.
Toward	50	1.5
Away from	50	1.1
Toward	100	2.2
Away from	100	0.9
Toward	180	3.0
Away from	180	0.7
At 90 degrees	50	1.0
At 90 degrees	100	1.1
At 90 degrees	180	1.5

In addition to the tests recorded in the above table 100 ft. of earth wire was so disposed that 50 ft. pointed away from S and 50 ft. toward S. The ratio of the efficiency of this arangement to that of the standard was 1.7. The system just referred to was then arranged so that 50 ft. pointed toward S and 50 ft. at 90 deg. to S. The ratio of efficiency in this case was unity.

A wire 25 ft. in length was buried 2 in. deep in moist earth and pointing toward S. This was compared with a wire of equal length and direction, but laid loosely on the grass. The ratio of efficiency proved to be unity, though

THE ELECTRICAL WORLD'S

STREET-LIGHTING TABLES FOR 1912

TWENTY-THIRD YEAR

These schedules are based on local mean time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made.

Time from noon until midnight is in bold-face type; that from midnight until noon in light type. The light type shows time for the morning following the date of the night indicated.

January, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**5:15**	6:20	**4:30**	6:20	**5:15**	**12:00**
1	....	....	....	....	4:30	6:20
2	**5:15**	6:20	No	light	**5:15**	**12:00**
3	**5:15**	6:20	No	light	**5:15**	**12:00**
4	**5:15**	6:20	No	light	**5:15**	**12:00**
5	**5:15**	6:20	**5:15**	**7:00**	**5:15**	**12:00**
6	**5:15**	6:20	**5:15**	**8:20**	**5:15**	**12:00**
7	**5:20**	6:20	**5:20**	**9:40**	**5:20**	**12:00**
8	**5:20**	6:20	**5:20**	**10:55**	**5:20**	**12:00**
9	**5:20**	6:20	**5:20**	12:05	**5:20**	12:05
10	**5:20**	6:20	**5:20**	1:15	**5:20**	1:15
11	**5:20**	6:20	**5:20**	2:20	**5:20**	2:20
12	**5:25**	6:20	**5:25**	3:30	**5:25**	3:30
13	**5:25**	6:20	**5:25**	4:35	**5:25**	4:35
14	**5:25**	6:20	**5:25**	5:40	**5:25**	5:40
15	**5:25**	6:15	**5:25**	6:15	**5:25**	6:15
16	**5:25**	6:15	**5:25**	6:15	**5:25**	6:15
17	**5:30**	6:15	**5:30**	6:15	**5:30**	6:15
18	**5:30**	6:15	**5:30**	6:15	**5:30**	6:15
19	**5:30**	6:15	**5:30**	6:15	**5:30**	6:15
20	**5:30**	6:15	**5:30**	6:15	**5:30**	6:15
21	**5:30**	6:15	**6:05**	6:15	**5:30**	6:15
22	**5:35**	6:15	**7:10**	6:15	**5:35**	6:15
23	**5:35**	6:15	**8:15**	6:15	**5:35**	6:15
24	**5:35**	6:15	**9:20**	6:15	**5:35**	6:15
25	**5:40**	6:10	**10:30**	6:10	**5:40**	6:10
26	**5:40**	6:10	**11:35**	6:10	**5:40**	6:10
27	**5:40**	6:10	12:50	6:10	**5:40**	6:10
28	**5:40**	6:10	2:10	6:10	**5:40**	**12:00**
28	....	....	....	....	2:10	6:10
29	**5:45**	6:10	3:25	6:10	**5:45**	**12:00**
29	....	....	....	....	3:25	6:10
30	**5:45**	6:10	4:35	6:10	**5:45**	**12:00**
30	....	....	....	....	4:35	6:10
31	**5:45**	6:05	No	light	**5:45**	**12:00**

February, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**5:45**	6:05	No	light	**5:45**	**12:00**
2	**5:45**	6:05	No	light	**5:45**	**12:00**
3	**5:45**	6:05	**5:45**	**7:30**	**5:45**	**12:00**
4	**5:45**	6:05	**5:45**	**8:30**	**5:45**	**12:00**
5	**5:50**	6:00	**5:50**	**9:45**	**5:50**	**12:00**
6	**5:50**	6:00	**5:50**	**11:00**	**5:50**	**12:00**
7	**5:55**	6:00	**5:55**	12:10	**5:55**	12:10
8	**5:55**	6:00	**5:55**	1:15	**5:55**	1:15
9	**5:55**	6:00	**5:55**	2:25	**5:55**	2:25
10	**5:55**	5:55	**5:55**	3:30	**5:55**	3:30
11	**6:00**	5:55	**6:00**	4:30	**6:00**	4:30
12	**6:00**	5:55	**6:00**	5:30	**6:00**	5:30
13	**6:00**	5:55	**6:00**	5:55	**6:00**	5:55
14	**6:05**	5:50	**6:05**	5:50	**6:05**	5:50
15	**6:05**	5:50	**6:05**	5:50	**6:05**	5:50
16	**6:05**	5:50	**6:05**	5:50	**6:05**	5:50
17	**6:10**	5:50	**6:10**	5:50	**6:10**	5:50
18	**6:10**	5:45	**6:10**	5:45	**6:10**	5:45
19	**6:10**	5:45	**6:10**	5:45	**6:10**	5:45
20	**6:10**	5:45	**7:15**	5:45	**6:10**	5:45
21	**6:10**	5:45	**8:20**	5:45	**6:10**	5:45
22	**6:10**	5:40	**9:30**	5:40	**6:10**	5:40
23	**6:15**	5:40	**10:40**	5:40	**6:15**	5:40
24	**6:15**	5:40	**11:55**	5:40	**6:15**	5:40
25	**6:15**	5:35	1:00	5:35	**6:15**	**12:00**
25	....	....	....	....	1:00	5:35
26	**6:15**	5:35	2:20	5:35	**6:15**	**12:00**
26	....	....	....	....	2:20	5:35
27	**6:15**	5:35	3:25	5:35	**6:15**	**12:00**
27	....	....	....	....	3:25	5:35
28	**6:20**	5:30	4:15	5:30	**6:20**	**12:00**
28	....	....	....	....	4:15	5:30
29	**6:20**	5:30	No	light	**6:20**	**12:00**

March, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**6:20**	5:30	No	light	**6:20**	**12:00**
2	**6:20**	5:30	No	light	**6:20**	**12:00**
3	**6:20**	5:30	No	light	**6:20**	**12:00**
4	**6:25**	5:25	**6:25**	**8:35**	**6:20**	**12:00**
5	**6:25**	5:25	**6:25**	**9:45**	**6:25**	**12:00**
6	**6:25**	5:20	**6:25**	**10:55**	**6:25**	**12:00**
7	**6:25**	5:20	**6:25**	12:05	**6:25**	12:05
8	**6:25**	5:20	**6:25**	1:15	**6:25**	1:15
9	**6:30**	5:20	**6:30**	2:20	**6:30**	2:20
10	**6:30**	5:15	**6:30**	3:20	**6:30**	3:20
11	**6:30**	5:15	**6:30**	4:15	**6:30**	4:15
12	**6:30**	5:15	**6:30**	5:00	**6:30**	5:00
13	**6:30**	5:10	**6:30**	5:10	**6:30**	5:10
14	**6:35**	5:10	**6:35**	5:10	**6:35**	5:10
15	**6:35**	5:10	**6:35**	5:10	**6:35**	5:10
16	**6:35**	5:05	**6:35**	5:05	**6:35**	5:05
17	**6:35**	5:05	**6:35**	5:05	**6:35**	5:05
18	**6:35**	5:05	**6:35**	5:05	**6:35**	5:05
19	**6:40**	5:05	**6:40**	5:05	**6:40**	5:05
20	**6:40**	5:00	**7:20**	5:00	**6:40**	5:00
21	**6:40**	5:00	**8:30**	5:00	**6:40**	5:00
22	**6:40**	4:55	**9:45**	4:55	**6:40**	4:55
23	**6:45**	4:55	**11:00**	4:55	**6:45**	4:55
24	**6:45**	4:55	12:10	4:55	**6:45**	4:55
25	**6:45**	4:55	1:15	4:55	**6:45**	**12:00**
25	....	....	....	....	1:15	4:55
26	**6:45**	4:50	2:10	4:55	**6:45**	**12:00**
26	....	....	....	....	2:10	4:55
27	**6:45**	4:50	2:55	4:55	**6:45**	**12:00**
27	....	....	....	....	2:55	4:55
28	**6:50**	4:50	3:30	4:50	**6:50**	**12:00**
28	....	....	....	....	3:30	4:50
29	**6:50**	4:45	3:55	4:45	**6:50**	**12:00**
30	**6:50**	4:45	No	light	**6:50**	**12:00**
31	**6:50**	4:45	No	light	**6:50**	**12:00**

April, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**6:50**	4:45	No	light	**6:50**	**12:00**
2	**6:55**	4:40	**6:55**	**8:35**	**6:55**	**12:00**
3	**6:55**	4:40	**6:55**	**9:45**	**6:55**	**12:00**
4	**6:55**	4:40	**6:55**	**10:55**	**6:55**	**12:00**
5	**6:55**	4:35	**6:55**	12:05	**6:55**	12:05
6	**6:55**	4:35	**6:55**	1:10	**6:55**	1:10
7	**7:00**	4:35	**7:00**	2:05	**7:00**	2:05
8	**7:00**	4:30	**7:00**	2:55	**7:00**	2:55
9	**7:00**	4:30	**7:00**	3:35	**7:00**	3:35
10	**7:00**	4:30	**7:00**	4:05	**7:00**	4:05
11	**7:00**	4:25	**7:00**	4:25	**7:00**	4:25
12	**7:05**	4:25	**7:05**	4:25	**7:05**	4:25
13	**7:05**	4:25	**7:05**	4:25	**7:05**	4:25
14	**7:05**	4:20	**7:05**	4:20	**7:05**	4:20
15	**7:05**	4:20	**7:05**	4:20	**7:05**	4:20

May, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**7:20**	4:00	No	light	**7:20**	**12:00**
2	**7:20**	4:00	**7:20**	**9:50**	**7:20**	**12:00**
3	**7:25**	3:55	**7:25**	**10:55**	**7:25**	**12:00**
4	**7:25**	3:55	**7:25**	**11:55**	**7:25**	**12:00**
5	**7:25**	3:55	**7:25**	12:45	**7:25**	12:45
6	**7:25**	3:50	**7:25**	1:30	**7:25**	1:30
7	**7:25**	3:45	**7:25**	2:05	**7:25**	2:05
8	**7:30**	3:45	**7:30**	2:35	**7:30**	2:35
9	**7:30**	3:45	**7:30**	3:00	**7:30**	3:00
10	**7:30**	3:45	**7:30**	3:20	**7:30**	3:20
11	**7:30**	3:45	**7:30**	3:40	**7:30**	3:40
12	**7:30**	3:45	**7:30**	3:45	**7:30**	3:45
13	**7:35**	3:45	**7:35**	3:45	**7:35**	3:45
14	**7:35**	3:45	**7:35**	3:45	**7:35**	3:45
15	**7:35**	3:40	**7:35**	3:40	**7:35**	3:40

June, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	**7:50**	3:35	**7:50**	**10:40**	**7:50**	**12:00**
2	**7:50**	3:35	**7:50**	**11:25**	**7:50**	**12:00**
3	**7:50**	3:35	**7:50**	12:05	**7:50**	12:05
4	**7:50**	3:35	**7:50**	12:35	**7:50**	12:35
5	**7:50**	3:35	**7:50**	1:00	**7:50**	1:00
6	**7:55**	3:35	**7:55**	1:25	**7:55**	1:25
7	**7:55**	3:35	**7:55**	1:45	**7:55**	1:45
8	**7:55**	3:35	**7:55**	2:00	**7:55**	2:00
9	**7:55**	3:35	**7:55**	2:20	**7:55**	2:20
10	**7:55**	3:35	**7:55**	2:40	**7:55**	2:40
11	**7:55**	3:35	**7:55**	3:05	**7:55**	3:05
12	**7:55**	3:30	**7:55**	3:30	**7:55**	3:30
13	**7:55**	3:30	**7:55**	3:30	**7:55**	3:30
14	**7:55**	3:30	**7:55**	3:30	**7:55**	3:30
15	**7:55**	3:30	**7:55**	3:30	**7:55**	3:30

April, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	6:50	4:45	No	light	6:50	12:00
2	6:55	4:40	6:55	8:35	6:55	12:00
3	6:55	4:40	6:55	9:45	6:55	12:00
4	6:55	4:40	6:55	10:55	6:55	12:00
5	6:55	4:35	6:55	12:05	6:55	12:05
6	6:55	4:35	6:55	1:10	6:55	1:10
7	7:00	4:35	7:00	2:05	7:00	2:05
8	7:00	4:30	7:00	2:55	7:00	2:55
9	7:00	4:30	7:00	3:35	7:00	3:35
10	7:00	4:30	7:00	4:05	7:00	4:05
11	7:00	4:25	7:00	4:25	7:00	4:25
12	7:05	4:25	7:05	4:25	7:05	4:25
13	7:05	4:25	7:05	4:25	7:05	4:25
14	7:05	4:20	7:05	4:20	7:05	4:20
15	7:05	4:20	7:05	4:20	7:05	4:20
16	7:05	4:20	7:05	4:20	7:05	4:20
17	7:10	4:15	7:10	4:15	7:10	4:15
18	7:10	4:15	7:30	4:15	7:10	4:15
19	7:10	4:15	8:50	4:15	7:10	4:15
20	7:10	4:10	10:05	4:10	7:10	4:10
21	7:10	4:10	11:10	4:10	7:10	4:10
22	7:15	4:10	12:10	4:10	7:15	4:10
23	7:15	4:05	12:55	4:05	7:15	4:05
24	7:15	4:05	1:30	4:05	7:15	12:00
24	...	....	....	....	1:30	4:05
25	7:15	4:05	2:00	4:05	7:15	12:00
25	...	....	....	....	2:00	4:05
26	7:20	4:05	2:25	4:05	7:20	12:00
26	...	....	....	....	2:45	4:05
27	7:20	4:00	2:45	4:00	7:20	12:00
27	....	....	....	....	2:45	4:00
28	7:20	4:00	3:00	4:00	7:20	12:00
29	7:20	4:00	No	light	7:20	12:00
30	7:20	4:00	No	light	7:20	12:00

May, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	7:20	4:00	No	light	7:20	12:00
2	7:20	4:00	7:20	9:50	7:20	12:00
3	7:25	3:55	7:25	10:55	7:25	12:00
4	7:25	3:55	7:25	11:55	7:25	12:00
5	7:25	3:55	7:25	12:45	7:25	12:45
6	7:25	3:50	7:25	1:30	7:25	1:30
7	7:25	3:45	7:25	2:05	7:25	2:05
8	7:30	3:45	7:30	2:35	7:30	2:35
9	7:30	3:45	7:30	3:00	7:30	3:00
10	7:30	3:45	7:30	3:20	7:30	3:20
11	7:30	3:45	7:30	3:40	7:30	3:40
12	7:30	3:45	7:30	3:45	7:30	3:45
13	7:35	3:45	7:35	3:45	7:35	3:45
14	7:35	3:45	7:35	3:45	7:35	3:45
15	7:35	3:40	7:35	3:40	7:35	3:40
16	7:35	3:40	7:35	3:40	7:35	3:40
17	7:35	3:40	7:35	3:40	7:35	3:40
18	7:40	3:40	9:00	3:40	7:40	3:40
19	7:40	3:40	10:00	3:40	7:40	3:40
20	7:40	3:40	10:55	3:40	7:40	3:40
21	7:40	3:35	11:33	3:35	7:40	3:35
22	7:40	3:35	12:05	3:35	7:40	3:35
23	7:45	3:35	12:30	3:35	7:45	3.35
24	7:45	3:35	12:50	3:35	7:45	3:35
25	7:45	3:35	1:10	3:35	7:45	12:00
25	....	....	....	....	1:10	3:35
26	7:45	3:35	1:30	3:35	7:45	12:00
26	...	....	....	....	1:30	3:35
27	7:45	3:35	1:55	3:35	7:45	12:00
27	...	....	....	....	1:55	3:55
28	7:45	3:35	2:20	3:35	7:45	12:00
29	7:45	3:35	No	light	7:45	12:00
30	7:45	3:30	No	light	7:45	12:00
31	7:45	3:30	No	light	7:45	12:00

June, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	7:50	3:35	7:50	10:40	7:50	12:00
2	7:50	3:35	7:50	11:25	7:50	12:00
3	7:50	3:35	7:50	12:05	7:50	12:05
4	7:50	3:35	7:50	12:35	7:50	12:35
5	7:50	3:35	7:50	1:00	7:50	1:00
6	7:55	3:35	7:55	1:25	7:55	1:25
7	7:55	3:35	7:55	1:45	7:55	1:45
8	7:55	3:35	7:55	2:00	7:55	2:00
9	7:55	3:35	7:55	2:20	7:55	2:20
10	7:55	3:35	7:55	2:40	7:55	2:40
11	7:55	3:35	7:55	3:05	7:55	3:05
12	7:55	3:30	7:55	3:30	7:55	3:30
13	7:55	3:30	7:55	3:30	7:55	3:30
14	7:55	3:30	7:55	3:30	7:55	3:30
15	7:55	3:30	7:55	3:30	7:55	3:30
16	7:55	3:30	7:55	3:30	7:55	3:30
17	8:00	3:30	9:30	3:30	8:00	3:30
18	8:00	3:30	10:05	3:30	8:00	3:30
19	8:00	3:30	10:30	3:30	8:00	3:30
20	8:00	3:30	10:55	3:30	8:00	3:30
21	8:00	3:30	11:05	3:30	8:00	3:30
22	8:00	3:30	11:40	3:30	8:00	3:30
23	8:00	3:30	12:00	3:30	8:00	3:30
24	8:00	3:30	12:25	3:30	8:00	3:30
25	8:00	3:30	12:50	3:30	8:00	3:30
26	8:00	3:30	1:25	3:30	8:00	12:00
26	....	....	....	....	1:25	3:30
27	8:00	3:30	No	light	8:00	12:00
28	8:00	3:30	No	light	8:00	12:00
29	8:00	3:30	No	light	8:00	12.00
30	8:00	3:30	8:00	10:05	8:00	12:00

July, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	8:00	3:30	8:00	10:35	8:00	12:00
2	8:00	3:30	8:00	11:05	8:00	12:00
3	8:00	3:30	8:00	11:25	8:00	12:00
4	8:00	3:30	8:00	11:45	8:00	12:00
5	8:00	3:30	8:00	12:05	8:00	12:05
6	8:00	3:30	8:00	12:25	8:00	12:25
7	8:00	3:30	8:00	12:45	8:00	12:45
8	8:00	3:30	8:00	1:05	8:00	1:05
9	8:00	3:35	8:00	1:30	8:00	1:30
10	8:00	3:35	8:00	2:05	8:00	2:05

August, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	7:40	3:55	7:40	10:10	7:40	12:00
2	7:40	3:55	7:40	10:30	7:40	12:00
3	7:40	4:00	7:40	10:45	7:40	12:00
4	7:40	4:00	7:40	11:10	7:40	12:00
5	7:35	4:00	7:35	11:30	7:35	12:00
6	7:35	4:00	7:35	12:00	7:35	12:00
7	7:35	4:00	7:35	12:40	7:35	12:40
8	7:35	4:00	7:35	1:35	7:35	1:35
9	7:30	4:05	7:30	2:40	7:30	2:40
10	7:30	4:05	7:30	4:00	7:30	4:00

September, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	7:00	4:25	7:00	9:35	7:00	12:00
2	7:00	4:25	7:00	10:05	7:00	12:00
3	6:55	4:30	6:55	10:35	6:55	12:00
4	6:55	4:30	6:55	11:20	6:55	12:00
5	6:55	4:30	6:55	12:20	6:55	12:20
6	6:50	4:30	6:50	1:30	6:50	1:30
7	6:50	4:30	6:50	2:50	6:50	2:50
8	6:50	4:30	6:50	4:15	6:50	4:15
9	6:45	4:35	6:45	4:35	6:45	4:35
10	6:45	4:35	6:45	4:35	6:45	4:35

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
4	8:00	3:30	8:00	11:45	8:00	12:00
5	8:00	3:30	8:00	12:05	8:00	12:05
6	8:00	3:30	8:00	12:25	8:00	12:25
7	8:00	3:30	8:00	12:45	8:00	12:45
8	8:00	3:30	8:00	1:05	8:00	1:05
9	8:00	3:35	8:00	1:30	8:00	1:30
10	8:00	3:35	8:00	2:05	8:00	2:05
11	7:55	3:35	7:55	2:55	7:55	2:55
12	7:55	3:35	7:55	3:35	7:55	3:35
13	7:55	3:35	7:55	3:35	7:55	3:35
14	7:55	3:40	7:55	3:40	7:55	3:40
15	7:55	3:40	7:55	3:40	7:55	3:40
16	7:55	3:40	8:30	3:40	7:55	3:40
17	7:55	3:45	9:00	3:45	7:55	3:45
18	7:55	3:45	9:20	3:45	7:55	3:45
19	7:55	3:45	9:40	3:45	7:55	3:45
20	7:50	3:45	10:00	3:45	7:50	3:45
21	7:50	3:45	10:25	3:45	7:50	3:45
22	7:50	3:45	10:55	3:45	7:50	3:45
23	7:50	3:50	11:25	3:50	7:50	3:50
24	7:50	3:50	12:05	3:50	7:50	3:50
25	7:50	3:50	12:50	3:50	7:50	3:50
26	7:50	3:50	1:45	3:50	7:50	12:00
26	...	....	....	....	1:45	3:50
27	7:45	3:50	No	light	7:45	12:00
28	7:45	3:55	No	light	7:45	12:00
29	7:45	3:55	No	light	7:45	12:00
30	7:45	3:55	7:45	9:30	7:45	12:00
31	7:40	3:55	7:40	9:50	7:40	12:00

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
4	7:40	4:00	7:40	11:10	7:40	12:00
5	7:35	4:00	7:35	11:30	7:35	12:00
6	7:35	4:00	7:35	12:00	7:35	12:00
7	7:35	4:00	7:35	12:40	7:35	12:40
8	7:35	4:00	7:35	1:35	7:35	1:35
9	7:30	4:05	7:30	2:40	7:30	2:40
10	7:30	4:05	7:30	4:00	7:30	4:00
11	7:30	4:05	7:30	4:05	7:30	4:05
12	7:30	4:05	7:30	4:05	7:30	4:05
13	7:25	4:05	7:25	4:05	7:25	4:05
14	7:25	4:10	7:25	4:10	7:25	4:10
15	7:25	4:10	7:25	4:10	7:25	4:10
16	7:25	4:10	8:05	4:10	7:25	4:10
17	7:20	4:10	8:30	4:10	7:20	4:10
18	7:20	4:10	8:55	4:10	7:20	4:10
19	7:20	4:15	9:25	4:15	7:20	4:15
20	7:15	4:15	10:05	4:15	7:15	4:15
21	7:15	4:15	10:50	4:15	7:15	4:15
22	7:15	4:15	11:40	4:15	7:15	4:15
23	7:15	4:15	12:40	4:15	7:15	4:15
24	7:10	4:20	1:40	4:20	7:10	12:00
24	...	....	....	....	1:40	4:20
25	7:10	4:20	2:45	4:20	7:10	12:00
25	...	....	....	....	2:45	4:20
26	7:10	4:20	No	light	7:10	12:00
27	7:05	4:20	No	light	7:05	12:00
28	7:05	4:20	No	light	7:05	12:00
29	7:05	4:25	7:05	8:35	7:05	12:00
30	7:05	4:25	7:05	8:55	7:05	12:00
31	7:00	4:25	7:00	9:15	7:00	12:00

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
5	6:55	4:30	6:55	12:20	6:55	12:20
6	6:50	4:30	6:50	1:30	6:50	1:30
7	6:50	4:30	6:50	2:50	6:50	2:50
8	6:50	4:30	6:50	4:15	6:50	4:15
9	6:45	4:35	6:45	4:35	6:45	4:35
10	6:45	4:35	6:45	4:35	6:45	4:35
11	6 45	4:35	6:45	4:35	6:45	4:35
12	6:40	4:35	6:40	4:35	6:40	4:35
13	6:40	4:35	6:40	4:35	6:40	4:35
14	6:40	4:35	6:40	4:35	6:40	4:35
15	6:35	4:40	7:25	4:40	6:35	4:40
16	6:35	4:40	8:00	4:40	6:35	4:40
17	6:35	4:40	8:40	4:40	6:35	4:40
18	6:30	4:40	9:30	4:40	6:30	4:40
19	6:30	4:45	10:30	4:45	6:30	4:45
20	6:30	4:45	11:30	4:45	6:30	4:45
21	6:25	4:45	12:35	4:45	6:25	4:45
22	6:25	4:45	1:40	4:45	6:25	12:00
22	...	....	....	....	1:40	4:45
23	6:25	4:45	2:45	4:45	6:25	12:00
23	...	....	....	....	2:45	4:45
24	6:20	4:50	No	light	6:20	12:00
25	6:20	4:50	No	light	6:20	12:00
26	6:20	4:50	No	ligh	6:20	12:00
27	6:15	4:50	No	light	6:15	12:00
28	6:15	4:55	6:15	7:40	6:15	12:00
29	6:15	4:55	6:15	8:05	6:15	12:00
30	6:15	4:55	6:15	8:40	6:15	12:00

October, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	6:10	4:55	6:10	9:20	6:10	12:00
2	6:10	4:55	6:10	10:10	6:10	12:00
3	6:05	5:00	6:05	11:15	6:05	12:00
4	6:05	5:00	6:05	12:30	6:05	12:30
5	6:05	5:00	6:05	1:50	6:05	1:50
6	6:05	5:00	6:05	2:10	6:05	2:10
7	6:00	5:00	6:00	3:30	6:00	3:30
8	6:00	5:05	6:00	4:45	6:00	4:45
9	6:00	5:05	6:00	5:05	6:00	5:05
10	5:55	5:05	5:55	5:05	5:55	5:05
11	5:55	5:05	5:55	5:05	5:55	5:05
12	5:55	5:05	5:55	5:05	5:55	5:05
13	5:50	5:10	5:50	5:10	5:50	5:10
14	5:50	5:10	6:30	5:10	5:50	5:10
15	5:50	5:10	7:30	5:10	5:50	5:10
16	5:45	5:10	8:20	5:10	5:45	5:10
17	5:45	5:10	9:20	5:10	5:45	5:10
18	5:45	5:15	10:25	5:15	5:45	5:15
19	5:45	5:15	11:25	5:15	5:45	5:15
20	5:40	5:15	12:30	5:15	5:40	5:15
21	5:40	5:15	1:35	5:15	5:40	12:00
21	...	....	....	....	1:35	5:15
22	5:40	5:20	2:40	5:20	5:40	12:00
22	...	....	....	....	2:40	5:20
23	5:35	5:20	3:45	5:20	5:35	12:00
23	...	....	....	....	3:45	5:20
24	5:35	5:20	No	light	5:35	12:00
25	5:35	5:20	No	light	5:35	12:00
26	5:35	5:20	No	light	5:35	12:00
27	5:30	5:25	5:30	6:40	5:30	12:00
28	5:30	5:25	5:30	7:20	5:30	12:00
29	5:30	5:25	5:30	8:10	5:30	12:00
30	5:30	5:25	5:30	9:10	5:30	12:00
31	5:25	5:30	5:30	10:20	5:25	12:00

November, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	5:25	5:30	5:25	11:40	5:25	12:00
2	5:25	5:30	5:25	1:00	5:25	1:00
3	5:20	5:30	5:20	2:15	5:20	2:15
4	5:20	5:30	5:20	3:30	5:20	3:30
5	5:20	5:35	5:20	4:45	5:20	4:45
6	5:20	5:35	5:20	5:35	5:20	5:35
7	5:20	5:35	5:20	5:35	5:20	5:35
8	5:20	5:35	5:20	5:35	5:20	5:35
9	5:15	5:40	5:15	5:40	5:15	5:40
10	5:15	5:40	5:15	5:40	5:15	5:40
11	5:15	5:40	5:15	5:40	5:15	5:40
12	5:15	5:40	5:15	5:40	5:15	5:40
13	5:15	5:40	7:05	5:40	5:15	5:40
14	5:10	5:45	8:10	5:45	5:10	5:45
15	5:10	5:45	9:15	5:45	5:10	5:45
16	5:10	5:45	10:15	5:45	5:10	5:45
17	5:10	5:50	11:20	5:50	5:10	5:50
18	5:10	5:50	12:25	5:50	5:10	5:50
19	5:10	5:50	1:25	5:50	5:10	12:00
19	...	....	....	....	1:25	5:50
20	5:10	5:50	2:35	5:50	5:10	12:00
20	...	....	....	....	2:35	5:50
21	5:05	5:55	3:40	5:55	5:05	12:00
21	...	....	....	....	3:40	5:55
22	5:05	5:55	No	light	5:05	12:00
23	5:05	5:55	No	light	5:05	12:00
24	5:05	5:55	No	light	5:05	12:00
25	5:05	6:00	5:05	6:00	5:05	12:00
26	5:05	6:00	5:05	7:00	5:05	12:00
27	5:05	6:00	5:05	8:10	5:05	12:00
28	5:05	6:00	5:05	9:30	5:05	12:00
29	5:05	6:00	5:05	10:45	5:05	12:00
30	5:05	6:00	5:05	12:05	5:05	12:05

December, 1912

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting.	Light	Exting.
1	5:05	6:00	5:05	1:20	5:05	1:20
2	5:05	6:05	5:05	2:35	5:05	2:35
3	5:05	6:05	5:05	3:45	5:05	3:45
4	5:05	6:05	5:05	4:55	5:05	4:55
5	5:05	6:05	5:05	6:05	5:05	6:05
6	5:05	6:05	5:05	6:05	5:05	6:05
7	5:05	6:10	5:05	6:10	5:05	6:10
8	5:05	6:10	5:05	6:10	5:05	6:10
9	5:05	6:10	5:05	6:10	5:05	6:10
10	5:05	6:10	5:05	6:10	5:05	6:10
11	5:05	6:10	5:05	6:10	5:05	6.10
12	5:05	6:15	7:00	6:15	5:05	6:15
13	5:05	6:15	8:05	6:15	5:05	6:15
14	5:05	6:15	9:10	6:15	5:05	6:15
15	5:05	6:15	10:10	6:15	5:05	6:15
16	5:05	6:15	11:10	6:15	5:05	6:15
17	5:05	6:15	12:15	6:15	5:05	6:15
18	5:05	6:15	1:20	6:15	5:05	12:00
18	...	....	....	....	1:20	6:15
19	5:05	6:15	2:30	6:15	5:05	12:00
19	...	....	....	....	2:30	6:15
20	5:05	6:15	3:45	6:15	5:05	12:00
20	...	....	....	....	3:45	6:15
21	5:05	6:15	No	light	5:05	12:00
22	5:05	6:15	No	light	5:05	12:00
23	5:05	6:20	No	light	5:05	12:00
24	5:05	6:20	No	light	5:05	12:00
25	5:10	6:20	5:10	7:10	5:10	12:00
26	5:10	6:20	5:10	8:30	5:10	12:00
27	5:10	6:20	5:10	9:50	5:10	12:00
28	5:10	6:20	5:10	11:10	5:10	12:00
29	5:10	6:20	5:10	12:25	5:10	12:25
30	5:10	6:20	5:10	1:35	5:10	1:35
31	5:10	6:20	5:10	2:45	5:10	2:45

on a subsequent date the buried wire showed a somewhat higher efficiency than the one laid upon the grass.

A number of earth wires, each 25 ft. in length, were arranged radially upon the grass and pointing in the general direction of S, being roughly 30 deg. apart. The wire pointing directly toward S was connected and the energy noted. An adjacent wire was added to the arrangement and the energy again read. While it was found difficult to duplicate a given set of readings, the data clearly indicated that additional wires, after the first two or three, added little if any to the efficiency of the system. Following is a typical set of readings:

Type of "Earth."	Shunt Resistance to Produce Silence in Telephones.
Standard	70
1 Wire	70
2 Wires	55
3 Wires	45
4 Wires	45
5 Wires	45
6 Wires	45

The general effect of an earth connection when employing a horizontal aerial was also investigated. A section of wire 50 ft. in length was supported on insulators at a height of 2 ft. from the ground. The system was in line with S. Owing to the fact that it was necessary to move the instruments from place to place, only qualitative observations were made. The detecting instruments were first connected to the end nearest S, a wire stuck into the ground serving as an earth connection. A test was made to determine whether grounding the opposite or free end would affect the efficiency of the system. With the opposite end free the signals were clear and readable. Grounding the free end produced no apparent change in the strength of these signals. The instruments were then moved to the end farthest away from S. With the opposite end free very faint signals resulted, as was to be expected from Marconi's law of horizontal aerials. However, on grounding the free end the strength of the signals decidedly increased in intensity, being of the same order of magnitude as those heard when the instruments were connected to the other end of the aerial.

The above horizontal aerial was cut in the middle and the detecting apparatus inserted so that 25 ft. of wire pointed either way in line with station S. With the free ends unearthed no signals could be heard, but on grounding the end farthest away from S faint signals could be detected. On grounding the end nearest S and having the other end free stronger signals resulted. On grounding both free ends the signals were materially stronger.

The above aerial system was changed to a position at right angles to a line joining the two stations. With the detector in the middle of the system no signals could be heard. When both free ends were earthed very faint signals could be detected. With the above two 25-ft. lengths joined and the detector connected to one end of the resulting 50 ft. of wire faint signals were heard. On grounding the free end no signals could be detected. It will be noted that this is opposite in effect to the case when the aerial was in line with station S.

Owing to the fact that this investigation is not completed it is not the author's purpose at this time to enter into a general discussion of the significance of the above results. In passing, however, attention should be directed to the marked differences in the effect of the length and relative position of the various earth wires as indicated in the first table above. The effects produced by earthing the free end of a horizontal aerial are also of interest.

In closing it may be said that during the period covered by this investigation the earth's surface was more or less moist. Each system was carefully brought into resonance before making readings.

REINFORCEMENT OF DIRECT-CURRENT THREE-WIRE FEEDERS.

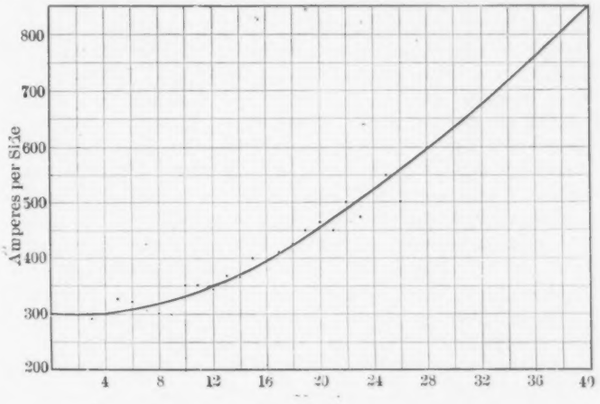
Economies and Practical Considerations Governing the Choice of Cables Larger than Necessary for Present Loads.

By A. W. WELCH.

IN selecting an economical cable system many points must be considered, some of which are discussed below. The cables must be designed for the lowest first cost of line and of central-station equipment commensurate with minimum cost of operation and maintenance, or to attain maximum income. But a primal consideration is that the customer shall receive normal voltage, as the income depends upon his satisfaction.

The present method of selecting a cable for use as a low-tension direct-current feeder is to estimate the load and then install a cable of sufficient size to carry it safely. When an existing three-wire feeder, of, say, 500,000 circ. mils cross-section per conductor, attains a peak load of 650 amp, it is time to consider its reinforcement. In low-tension three-wire distribution it is customary to use the approximate rule: Size of cable in circ. mils = carrying capacity in amp × 1000. Therefore, the feeder would be working for a period under an overload of 150 amp.

The distribution department of a company should always keep a record of the maximum loads per month occurring on each feeder. By plotting a curve as indicated and extending it an idea may be obtained as to the future load it will be called upon to carry. Consideration of this curve shows that the load has been steadily increasing for the past twenty-one months, so that it is reasonable to suppose that it will continue to increase to a certain extent, the limit depending upon the character of the neighborhood. For instance, a built-up residential district will have a definite load limit due to the fact that there are a given number of houses. As all the customers in such a district are using electrical energy for the same purposes and all future customers will want electricity for like purposes, it would be simple to estimate closely what the ultimate load will be. But in a section where large stores and office buildings are beginning to take the place of old-fashioned establishments it is difficult to forecast the load several years hence.



Load-Increase Curve of a 500,000-Circ. Mil, Three-Wire Feeder.

The illustration shows the load increase curve of a 500,000-circ. mil three-wire feeder situated in a section made up of residences and small shops. It shows that the load has been steadily increasing in almost a straight line for the past eighteen months, and during that period the monthly maximum has risen from 350 amp a side to 600. The feeder has been overloaded at least once a month for the past six months, and at the last point reached an overload of 20 per cent. Now, with the present practice fore-

sight would scarcely reach beyond a year, and by extending the curve for twelve months it is found that the maximum load to be expected at that time will be about 850 amp. Therefore, as the load should be balanced, two 350,000-circ. mil cables in multiple with the negative and positive legs of the existing feeder would take care of this increase.

With the present practice, either a 350,000-circ. mil auxiliary feeder or a smaller one would be installed, and the problem is, What would be the situation resulting from the installation of an auxiliary feeder of larger dimensions than would be necessary to handle the increasing load? Suppose a 500,000-circ. mil cable were used for reinforcing the original 500,000-circ. mil feeder previously considered. If this were done, a 1,000,000-circ. mil feeder would result instead of one of 850,000 circ. mils. The advantages of the larger feeder over the smaller are that enough copper is always present for increased loading, and it will not be necessary to have to reinforce the feeder for a longer period if the load should increase beyond the one-year estimate. The greater size will make burnouts less likely. Another point of some importance is that the line loss will be less. This will mean less demand upon the high-tension feeders and through them upon the generating station. The greatest saving in line loss will occur during the peak load and will, therefore, exert its greatest influence.

The approximate saving in money due to the reduction of the line loss on this feeder may be estimated as follows: The constants of the feeder are its length, which it will be assumed is 2000 ft.; its size, which will first be considered as 850,000 cir. mils and then as 1,000,000 circ. mils, and its specific resistance of 10.8 ohms per mil ft. The load conditions must now be determined by an estimate based upon present loads as tabulated hourly, or half-hourly on the station log sheets.

The following is the estimate of present load conditions on this feeder:

Average daily maximum load = 600 amp for 2 hours
50 per cent average daily maximum load = 300 amp for 2 hours
25 per cent average daily maximum load = 150 amp for 8 hours
10 per cent average daily maximum load = 60 amp for 12 hours

From this it is simple to determine the amp-hours for each load period, which are 1200 amp-hours during the two-hour peak, 600 for two hours, 1200 for eight hours, and 720 for twelve hours.

The next calculation will be for the purpose of determining the difference in voltage drop at peak load between the above two sizes. The drop in the case of the smaller cable is $10.8 \times 200 \times 600 \div 850{,}000 = 15.25$ volts, and the drop in the case of the larger cable is $10.8 \times 2000 \times 600 \div 1{,}000{,}000 = 12.96$ volts. The difference is therefore 2.29 volts.

The above table shows the saving in kw-hours due to the installation of the larger feeder. The total saving will be the sum of the four, or 4.3 kw-hours a day per side of the three-wire feeder, or 8.6 kw-hours for the total feeder, which at 2 cents per kw-hour amounts to 17.2 cents per day, or $62.78 a year.

This is, of course, a rather free method of arriving at the result, but is considered to be approximately correct, and an approximation is all that can be expected in an estimate.

The other advantages accruing from the installation of the larger feeder, such as the added safety and the fact that it will not require reinforcement so soon, should be worth at least as much again as the line loss saving; but the problem may be considered from the standpoint of line loss saving alone. The difference in cost between the 500,000-circ. mil and the 350,000-circ. mil reinforcements will be about $460. Therefore it may be readily determined by disregarding interest conditions that the saving of $62.78 a year will pay for the increased cable in less than seven and one-half years.

It is difficult to give any reasonable estimate of cable life without reference to conditions of installation. Under average conditions, however, an underground cable, if not disturbed and if properly protected from electroysis, should last at least twenty years. The most serious influences which operate to shorten the life of a feeder are lessened by increasing its cross-section, the load remaining constant. Assuming a cable life of twenty years, in the case of the problem just considered one may calculate that as the increased cost of reinforcement was paid for in seven and one-half years, there should be twelve and one-half years of life ahead for the feeder. At a saving of $62.78 a year at the end of the twelve and one-half years this will amount to $985; but as the load should have increased somewhat during this lapse the actual saving would be considerably greater. If interest on this income were taken into account the amount would be still further increased.

Table I shows the estimated conditions attending the selection of a cable of greater cross-section than is absolutely necessary for the conveyance of the current. The figures in the first column give the two sizes which are to be compared. For instance, what will be the saving accruing from the installation of a 750,000-circ. mil cable in place of a 500,000-circ. mil cable for the conveyance of 500 amp? Reading to the right along the line which contains

TABLE I.—SAVING DUE TO LARGER CABLES.

Sizes of Feeder, Circ. Mils.	Difference in *IR* Drop at Full Load of Smaller Feeder.	KW-HOUR SAVING DUE TO INCREASED COPPER.		Saving in Dollars per Year at 2 Cents per Kw-hour.	Cost of Additional Copper.	YEARS REQUIRED FOR SAVING TO PAY FOR ADDITIONAL EXPENDITURE	
		Per Day.	Per Year.			At 2 Cents per Kw-hour.	At 1 Cent per Kw-hour.
1,000,000..... 750,000.....	5.4	25.28	9,227	184.54	576.00	3.12	6.24
750,000..... 500,000.....	7.2	22.46	8,198	163.96	530.00	3.23	6.46
500,000..... 350,000.....	6.5	14.15	5,165	103.30	464.00	4.48	8.96
350,000..... 200,000.....	9.3	11.60	4,234	84.68	364.00	4.28	8.56

TABLE II.—CONDITION AT DIFFERENT PERCENTAGE OF PEAK LOAD.

	Two Hours, 100 per Cent.	Two Hours, 50 per Cent.	Eight Hours 25 per Cent.	Twelve Hours, 10 per Cent.
Load in amperes....	600.00	300.00	150.00	60.00
Amp-hours.....	1,200.00	600.00	1,200.00	720.00
Drop.....	2.29	1.15	0.57	0.23
Kw-hour loss.....	2.75	0.69	0.69	0.17

these sizes, one finds that the saving will be 22.46 kw-hours a day, 8198 kw-hours a year, which at 2 cents per kw-hour will produce an annual income of $163.96. As the additional expenditure for the copper amounts to $530, it will take a little over three years for this expense to be made up. The method used in calculating the kw-hour saving for each of the tabulated cases is based on full cable load for two hours, 50 per cent load for two hours, 25 per cent load for eight hours and 10 per cent load for the remaining twelve hours. For some locations these percentages will be high and for others low, but on the whole it seems to the writer to be a fair distribution of load. The actual price of energy per kw-hour will depend upon the company. Many will perhaps take exception to the 2-cent estimate and claim that it is too high. The last column of Table I gives the number of years required to pay for the increased copper by crediting the line loss saving at the rate of 1 cent per kw-hour.

The calculations are for reinforcement cables, and the additional copper will in each case consist of two legs of 2000 ft. each, because the load should be balanced on a three-wire feeder, making the reinforcement of the neutral unnecessary. Of course, in laying out a new feeder the difference in cost of three legs of each size must be considered. All engineers will agree that the larger feeder is more satisfactory from nearly every standpoint except that of first cost.

SOME NOTES ON EUROPEAN THREE-PHASE GAS-ENGINE PLANTS.

Gas-Engine-Driven Central Stations of from 2,000 kw to Over 40,000 kw in Germany Serving Mines, Rolling Mills, etc.

By Warren H. Miller.

THE Rhenish-Westphalian coal seams, which extend to the east from the Rhine as far as Unna and Karmen, are about 32 miles long and 9 to 14 miles wide. They are among the most productive in the world, surpassing those of England and surpassed only by those of Pennsylvania, and yield 80,000 tons of coal annually.

These enormous deposits have formed the basis for a corresponding development in the production of iron and steel. The Rhenish-Westphalian coal district now produces annually over 5,000,000 tons of pig-iron, forming about 40 per cent of the total output of Germany and nearly 10 per cent of that of the world. Most of the ore

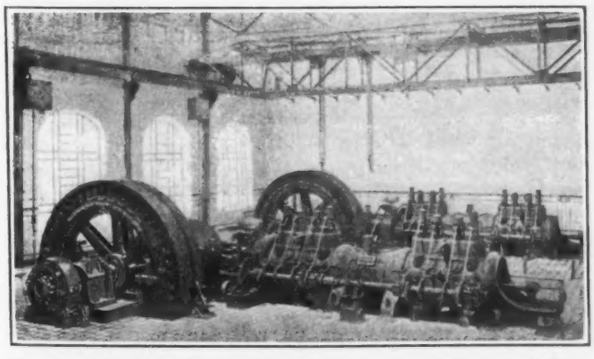


Fig. 1—Generating Room of the Consolidation Mines at Schalke.

used in this district must be imported from Sweden, as the iron deposits in Germany itself are very poor; in fact, the iron problem lies at the root of affairs in Morocco, where the Germans are at present operating rich mines and insist on being allowed to do so without interference from France.

The reception of the ore requires a navigable river and great harbor facilities, and hence Durisburg, at the confluence of the Rhine and the Ruhr, with its immense artificial basins, has become one of the greatest iron-making centers of Germany. The Ruhr is an insignificant stream, not over 75 feet wide, but every foot of its stone-lined bank is a docking place for canalboats loaded with ore,

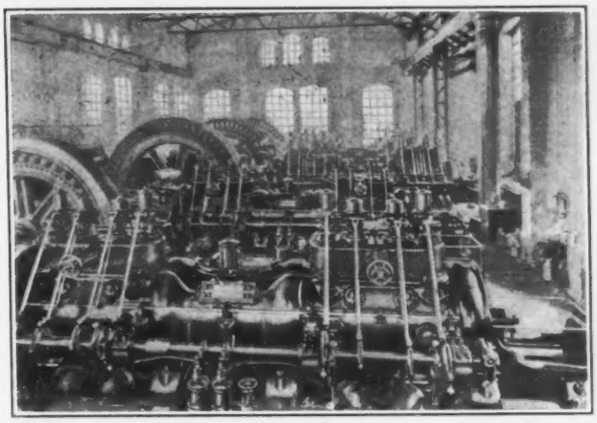


Fig. 2—Generating Room of the Phoenix Hütten, Ruhrort, Germany.

or pine timbers, or else pig-iron on its way outbound through Germany's network of waterways.

All through this district induction motors are used extensively for mine service, rolling mills, conveyors and isolated service of all kinds. Use is made of three-phase current, mostly of 50 cycles, running motors of 2000 volts for the mill rolls and 220-volt or 440-volt motors of 500 hp and less for other services. The fuel used is blast-furnace gas, though there have been a number of successful installations of coke-oven gas-driven central electric stations. The principal objection to coke-oven gas is the presence of sulphur, hard to eradicate, and a solution often resorted to is to burn the coke-oven gas under boilers and add a turbine-driven equipment, running in parallel with the gas-engine power houses.

The rapid development of this industry in Westphalia is one of the wonders of modern engineering. Instead of a few three-phase 60-cycle and 25-cycle plants scattered about the country as in America, there are in Westphalia around Durisburg and between it and Brussels alone some fourteen large electric central stations for three-phase drive, none of them less than 2000 kva in rating and aggregating 40,000 kva. With the exception of the Donnersmarkehütte in Zabrze, where there are two 800-kva, 1050-volt units, all of the engines are of the four-stroke cycle, though two-stroke cycle is receiving considerable development for direct current. The tandem two-cylinder arrangement appears to be the favorite, the electric constructive conditions being so much better than with twin engines. The universal frequency is 50 cycles, or, what amounts to the same thing, 47 and 48. The voltage ranges from 5600, as at the Rombacher Huttenwerke in Lorraine, or 5500, as at the Gewerkschaft Deutscher Kaiser in Bruchhausen (41,900 kva, 94 r.p.m., three-phase machines), to 2100-volt and 500-volt plants, 5500 being the favorite voltage. There are a few large plants, as at the 2100-hp plant of the Gutehoffungshütte at Oberhausen, with eight gas engines in parallel for three-phase electric drive. The universal system is with rotating field, the poles being mounted on the rim of a heavy flywheel with a simple copper damper on the pole pieces, consisting of seven or eight 5/8-in. round copper rods passing through holes drilled in the poles and riveted over short-circuiting bars at the ends. The speeds most used are 150, 125, 107, 100 and 94 r.p.m., the last two being the favorites for all sizes much larger than 70 kva.

The German angular speed requirements for parallel op-

eration are the same as the American, namely, 1/250 maximum permissible variation in angular rotation of the flywheel. The regulation is accomplished almost invariably by the inertia governor, and in the plants visited by the writer it was prompt, positive and efficient in the case of such disturbances as back-fires. The prime requisite is

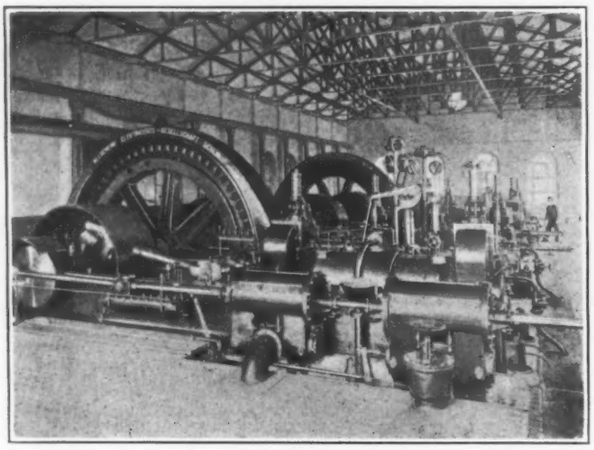


Fig. 3—Generating Room of the Donnersmarkehütte at Zabrze.

that the governor shall act sufficiently in advance of the change of speed in the entire engine to alter the driving power admitted in order to suit the new load. In this way is avoided the distressing hunting so frequently started by a back-fire in plants where the governor is too slow to alter the driving power.

Having heard so much of the smooth and quiet running of the large German central electric stations in blast-furnace works, and knowing something of American performances, the writer was very anxious to visit the Westphalia ore-smelting district and see them so as to judge for himself. Through the kindness of the Allgemeine Electricitäts Gesellschaft of Berlin, he was given entrée to some of the big "hütten," as the blast-furnace works are called, near Durisburg, particularly the three immense stations of the Phoenix Hütten, Ruhrort.

The latter works cover several square miles, the blast furnaces and rolling mills being built over their own mines. All of the rolls are electric-driven with 2000-volt, 2000-hp and 1200-hp non-reversing motors. Use is also made of 220-volt motors, mostly 500 hp, for running mine ventilator fans, conveyors, shipping machinery and blast-furnace apparatus. All of the small motors appeared to be of the variable-speed type. All of the electric lighting was done by direct current. Herr Oelrichs, the electrical engineer of the plant, spoke of running all his lamps next year on the three phases of his motor circuits, as is often done in America. As many new benches of coke ovens are now being built, he stated that next year it is proposed to put in a coke-gas-driven electric central station. The energy at present is generated in three central stations, the oldest containing three 930-kva, three-phase alternators with overhung field cores (the poles being attached to the inside rim of the flywheel), 100 r.p.m., 2100-volt, 47-cycle, driven by tandem two-cylinder four-stroke cycle gas engines operating on blast-furnace gas. There are also two 750-kva, three-phase alternators, 2100 volts at 140 r.p.m. with stator placed outside of the rotor, the field poles being mounted on the flywheel, according to the common construction. One other machine in this station was a 690-kva, 2100-volt generator driven at 94 r.p.m. by a tandem two-stroke-cycle gas engine. All of these were running in parallel peaceably enough, and also in parallel with units in the two other power houses. The 1200-hp motors at the rolls were constantly being placed in and taken out of service, and the load was fluctuating on all wattmeters from 100 to 200 kw every few seconds; however, the periodic swing due to interchange and play of the alternators on the varying load was not over 25 kw on each side of the normal position of the wattmeter needle. Each engine throughout the plant, in both No. 1 and 2 gas central station and in the turbine central station, is provided with a tachometer on a fixed standard. This arrangement seemed particularly praiseworthy, as these instruments not only indicated to the engine attendants at a glance the average speed of the engine but showed how it was behaving throughout each portion of each revolution—a most important thing to know instantly and accurately with gas engines in parallel. The 930-kva engine units, with overhung field poles, showed a very peculiar speed variation between 102 and 108 r.p.m., occurring periodically about every two revolutions, as if either the governor overtraveled slightly or the load was a little too great for steady angular flywheel speed. As the normal speed of these engines is 100 r.p.m., it is probable that they were underloaded and being held down with some difficulty by the governor. Their wattmeters showed only 700 kw. The 750-kva machines operated very steadily at from 138 r.p.m. to 139 r.p.m. Their wattmeters indicated from 500 kw to 600 kw. This equipment was installed in 1903, the engines having been built by Haniel & Leug, of Dusseldorf, licensees in Westphalia for the manufacture of the well-known Augsburg Nürnburg gas engines. The alternators and switchboard were built by the Allgemeine Company, of Berlin. The switchboard was of the usual high-tension, oil-switch, distance-control type.

In power house No. 2 are four 1680-kva, three-phase, 47-cycle, 2100-volt alternators driven at 94 r.p.m. by tandem two-cylinder four-stroke-cycle Augsburg engines, built by Haniel & Leug. The instruments showed loads fluctuating between 200 and 300 kw every few seconds. One engine was carrying from 900 kw to 1100 kw, the other two from 700 kw to 900 kw each, and one was not in operation. The variations were not over 30 kw on each side of normal position of the wattmeter needle for the time being, a very good performance even for blast-furnace gas. The switchboard of this plant was of the most modern construction, with each panel capable of being rolled out onto an iron wagon built for that purpose and repaired in the electrician's workshop, far from any current-carrying wires. All of the main panels were interchangeable and all possessed spring-lock lugs which hooked them into the main busbar leads when the panel was pushed home into its place. A safety lock made it impossible to disconnect the panel or put it onto the bars without the main oil-switch circuit-breaker being first shut off. Of course such a system as this is possible only with electrically operated oil switches, as the panel carries only the instruments, the instrument transformers and the electrical oil-switch operating device with its transformers. This board also possesses a double set of busbars, both being in a cellar under the board with double-throw switch for each panel. The emergency busbar is like the ones in American plants, being used for testing engines or division of the load between two distinct circuits. Use is made of a whistle system by which the board attendant would give one, two or three whistles, according to the number of the engine, immediately after a back-fire. The men on the floor could then go at once to the engine needing attention. In the same power house with these were two 4000-hp twin tandem two-cylinder gas engines built by Thyssen & Company, of Mulheim, which ran the blower pumps.

In power house No. 3 were two Allgemeine turbine sets, one of 1500 kva and one of 2500 kva, and one cross-compound ventil-geared reciprocating engine built in Dusseldorf. All of these were driven by steam at 11 atmospheres pressure with superheated steam raised under boilers with the spare coke-oven gas. The wattmeters indicated 2300 kw and 1100 kw respectively, showing that

both turbines were fully loaded. The fluctuation in both changed by from 200 kw to 300 kw every few seconds. The tachometers showed a speed variation of not over 20 r.p.m. around a normal value of 2900 r.p.m., which seemed a pretty good performance for the turbine governor under such load fluctuations. The coke-oven gas is burned under boilers and then the steam is used in turbines. There was no other use that could be made of the superfluous coke gas, but next year, after the new coke benches have been completed, the Phoenix company expects to install coke gas engines. This arrangement will represent no particular innovation in Westphalia, as witness the seven Augsburg-Nürnberg machines, aggregating 7500 hp, of the Eschweiler Bergswerk Verein in Eschweileraue, and two 620-kva Nürnburg three-phase, 3150-volt machines at Bochrun. The power-factor of the entire Phoenix works, all three power houses being in parallel, was 0.73, which is excellent for such a peculiar drive as a large blast furnace, rolling mill and coal-mine industry.

The Phoenix plant is fairly typical of what is being done with three-phase electric drive, not only in Westphalia but all over Belgium, France, Spain and other parts of Europe where coal and iron conditions invite large blast-furnace installations. For this service the three-phase plants outnumber the direct-current plants two to one.

POINTS OF INTEREST IN LAYOUT OF A NEW TURBINE STATION FOR LEXINGTON, KY.

The Lexington (Ky.) Utilities Company is erecting a modern new turbine station near the site of its old plant to furnish central-station service for Lexington and to operate the local and interurban railway lines of the allied Lexington & Interurban Railways Company. As initially completed the new station will contain two 2500-kw horizontal Curtis General Electric turbo-generators, developing 4000-volt, 60-cycle, three-phase energy, but it is capable of extension later. Following the tendency of recent engineering design away from 25-cycle railway generation where interoperation with a lighting plant is desirable, all railway energy will be converted to 550-volt direct current by motor-generator sets. Two 750-kw sets will be installed in the plant and others will be operated in substations along the 33,000-volt transmission line extending to Versailles and Frankfort, 28 miles distant.

The new plant, for which excavating is already completed, will be of concrete, brick and steel, measuring 141 ft. by 144 ft. in plan, and will be surmounted by a 12-ft. concrete stack 200 ft. high. The boiler-room is to be equipped with two new Edgemoor and two Babcock & Wilcox 5000-sq. ft. units, the latter to be removed from the present plant.

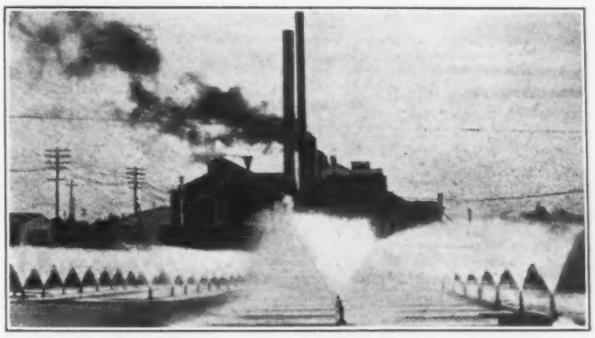
As is typical of small-plant design, the coal-handling apparatus will all be contained in the boiler-room, but the arrangement at Lexington is rather novel. The coal-car spur is to be extended into the station at a level about 6 ft. above the boiler-room floor and directly over the coal-storage pit, which will be 65 ft. long, 24 ft. wide and 20 ft. deep. From drop-bottom cars crushed coal can thus be discharged directly into the pit, while lump coal, with the aid of a three-ton traveling crane and grab bucket, may be lifted from the car and conveyed to the crusher hopper alongside the track. This crusher in turn empties into the pit beneath. The latter is of concrete with a waterproof surfacing, and provision will be made for turning water on to the coal to gain the advantages of submerged storage if this becomes desirable. From the coal-storage pit the crane bucket is again used to fill the small bunkers directly over the boilers. The latter units will be equipped with Foster superheaters to improve the quality of steam admitted to the turbines.

The provision of an extra smaller circulating pump indicates the effort to improve the efficiency of the large turbine units at partial loads. The two main motor-driven circulating pumps are 16 in. in diameter, delivering 7000 gal. per minute at 25 lb. pressure. The auxiliary 10-in. pump will deliver about one-third this quantity of water at the same pressure. This extra head on the circulating system is required in connection with the cooling-pond arrangement which is imposed by the local conditions surrounding the plant.

Lexington and its vicinity are without water-bearing strata, and surface water has to be relied on. Sufficient pondage for a year's supply is held in the city reservoir, 2 miles distant and a number of feet lower than the city. Owing to this absence of wells or streams all water for the plant must be purchased from the city at a cost of about 6 cents per 1000 gal. In the present plant, which contains both reciprocating and engine units, a cooling pond has been resorted to, as shown in the accompanying illustration. This pond measures roughly 230 ft. by 120 ft., and is sprayed by fifty nozzles mounted on 15-in. pipes. Ten to 12 lb. pressure per square inch is required at the nozzles. The present pond is capable only of about 800 kw cooling duty and normally has to be sprayed at full capacity twenty-four hours a day, including the light-load period, in order to cool it down for the heavier loads which have to be taken care of later.

The peculiar stratum formation underlying the city, alternate layers of rock and clay, permits such rapid seepage that an attempt to prepare a new cooling pond would probably be in vain. Accordingly the old pond, which is 700 ft. distant from the new station, will be enlarged to carry the additional load. When first dug it is said that this pond absorbed all the water that could be pumped into it for many days. The surrounding strata are now thoroughly saturated, however, and the make-up water required is practically limited to the loss by evaporation. The old pond will be cleaned and extended by several hundred feet and will be connected with the new plant, 700 ft. distant, by 30-in. discharge and intake lines.

An interesting load on the 33,000-volt line operated from this station will probably be the motor-power requirements of one of the largest and finest country estates in America. These combined farm and summer-home grounds, which cover 8000 acres of choice blue-grass pasturage, are already completely electrically equipped and served by an isolated



Oil Cooling Pond to Be Extended for New Station.

plant and several gas engines. These it is proposed to turn to central-station drive, and when this has been finished to the taste of the multi-millionaire owner it promises to be the show farm installation of the country.

Mr. W. F. Bacon, vice-president of the Lexington Utilities Company, has recently removed his office to Lexington and is in general charge of the rehabilitation of the company's plant and lines. Mr. J. P. Pope is general superintendent of the lighting department. Sargent & Lundy, Chicago, are the engineers for the new plant.

HANDLING LUMBER BY ELECTRICITY.

Electric Motors Employed for Every Operation in Lumber Yard.

By E. L. Barnett.

At the Pacific Coast meeting of the American Institute of Electrical Engineers a paper was read by Mr. Edward J. Barry giving a description of the application of electricity to the lumber industry at the sawmills and yards of the Potlatch Lumber Company, at Potlatch and Elk River, Idaho. Among other things, Mr. Barry described the application of electric storage-battery locomotives in transferring lumber from the sawmills to the dry-kiln and from the dry-kiln to the planing mill. During the discussion Mr. Ralph Bennett mentioned the fact that several monorail systems were in successful operation in the State of California and in the Southern States. It might also be mentioned that a number of electric traveling cranes, of both the runway and gantry types, are used for this service on the Pacific Coast.

It is the opinion of the writer that none of these methods should be employed as a complete system. Each has its own particular place, and the ideal system, especially where applied to existing yards, would be a combination of two or more of these particular methods of handling lumber.

The electric traveling crane, runway type, can cover a large area, and hence is applicable to removing lumber from the sorting table to the yard and in loading cars for shipment, the runways being so placed that the crane can cover a large area. However, this type is not adapted to moving loads over long hauls, the movement of the bridge being too slow, and a combination system should be adopted.

The runway type has a great advantage in loading and unloading, since the load can be moved in either direction at right angles and hence can be readily placed in any position. The first cost of a crane of this type with runways is high, although the maintenance should not be excessive if it is properly installed.

While the first cost of the gantry type will be greater than that of the runway type, it requires no expensive runways but only a simple track not much more expensive than the ordinary logging railroads, and the tracks can be so laid that the crane can be readily transferred from one section of the yard to another.

The monorail system is restricted to a narrow area almost directly under the monorail, and hence is applicable to the loading of cars on tracks parallel to each other and at right angles to the monorail. Since it is obvious that the monorail should be located with respect to a continuous supply, one logical location seems to be at the sorting table to remove piles of lumber to the cars for transfer. As this type requires only the trolley with trolley and hoist motors and electrical equipment for the same, and the monorail erected should cost less than the runways for the runway type, it is evident that this system should cost less than the latter for a given length of runway. Again, while the monorail erected will cost more than the track for the gantry type, the trolley with hoist and electrical equipment should cost much less than the gantry type of crane. However, to cover any considerable area will require an expensive installation of monorails.

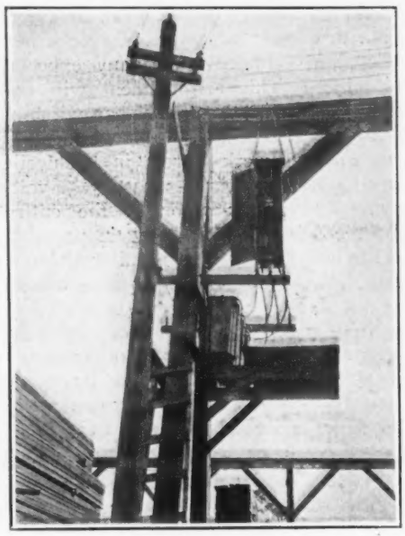


Fig. 2—Bank of Transformers for Crane Shown in Fig. 3.

The electric storage locomotive is especially adapted to moving large quantities of lumber over long or short hauls, and hence may be used in moving lumber about the yards and from the yards to the shipping points. The storage-battery type of locomotive is desirable through avoiding complicated systems of wiring that would interfere with the capacity of the storage yards, and in handling lumber in the yards.

The following is a brief description of the method used by the Union Lumber Company, of Fort Bragg, Cal., for handling lumber by electric power. All the lumber from this mill passes along a slowly moving sorting table, where it is first graded and then removed, by hand labor, to the piling forms. These piles are then removed by the electric traveling crane shown in Fig. 1, by means of a special sling, which will carry any amount up to 3000 ft., the load varying in weight from a few hundred pounds to approximately 6.5 tons. It may be interesting to note that this is redwood

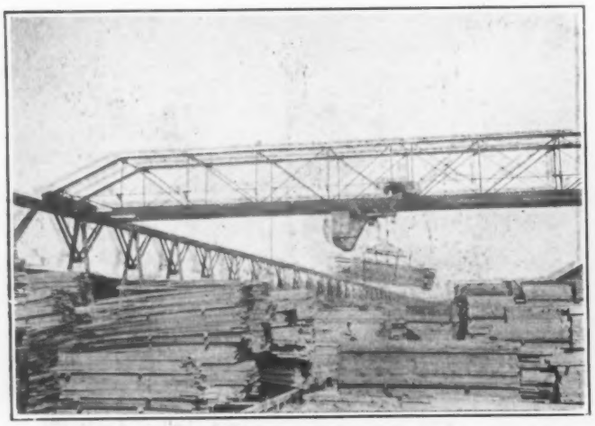


Fig. 1—Electric Crane Used by the Union Lumber Company.

Fig. 3—Crane at the Yards of Irvine Muir Lumber Company.

and fir lumber; the former varies greatly in weight and ranges as high as 5 lb. to the board foot.

The bridge of the crane is of 120 ft. span, and was designed for a load of 10 tons, 5 tons on each side. The bridge is driven by a 22-hp motor, the hoist by a 10-hp motor and the trolley by one of 5 hp. All are 220-volt,

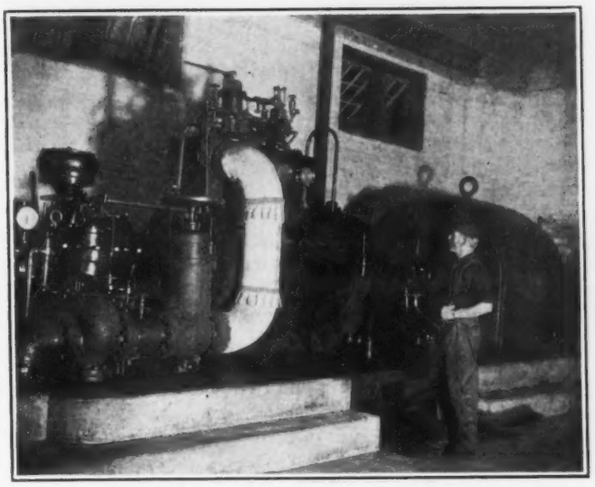


Fig. 4—940-kva Turbo-Generator at the Plant of Union Lumber Company.

60-cycle, three-phase induction motors. The trolley or carriage is of the monorail type. It was the intention to have one on each side of the bridge, but it has been found advisable to place an I-beam at the middle of the bridge and use but one trolley. It has been the purpose to use this crane in connection with a monorail system for handling the heavy timbers, and also for handling all kinds of lumber for distribution in the yard and for loading cars for shipment. At the present time all lumber is shipped by boats, being loaded on the cars by the crane and then run by gravity to the shipping wharf. In the future storage-battery locomotives may be used for transferring about the yards, in handling empty cars and for the necessary switching, horses being used for this purpose at the present time. This

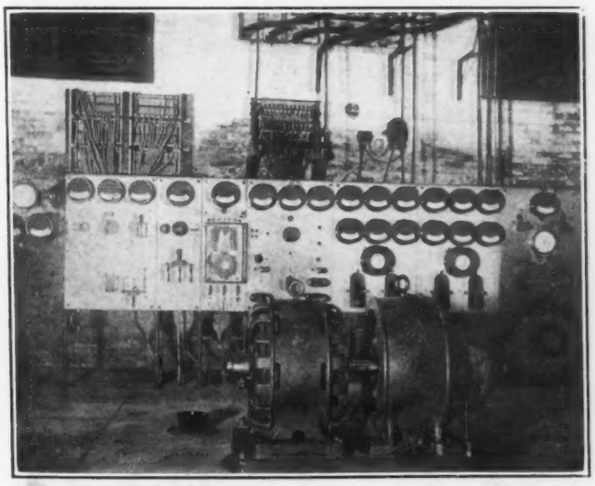


Fig. 5—Switchboard and Motor-Driven Exciter at the Plant of Union Lumber Company.

crane handles on the average approximately 120,000 ft. of lumber per day of ten hours over a haul of from 20 ft. to 600 ft. Over short hauls in loading cars for shipment the crane has handled as much as 40,000 ft. in one hour.

Fig. 3 shows the crane of the Irvine Muir Lumber Company. This company purchases power of the Union Lumber Company, and the crane and yards are located about 1 mile from the generating plant, current being supplied over a three-phase line at 2200 volts. Fig. 2 shows the bank of transformers for transforming to 220 volts. The secondary switch with meter is also plainly shown in a weatherproof box. In Fig. 4 is shown the 940-kva unit at the generating plant, and Fig. 5 shows the switchboard and motor-driven exciter. The generating plant also contains a 300-kva, 2200-volt generator, direct-connected to a four-valve engine.

WATER-SUPPLY SITUATION OF LOUISVILLE CENTRAL STATION.

TECHNICAL visitors to Louisville Ky., familiar with steam-plant operation in other riverside cities often remark with surprise the situation of the Louisville Light Company's 14,000-kw turbine condensing generating station, located almost a mile distant from the bank of the Ohio River, which might be expected to furnish the best source of condensing water. On account, however, of the wide variation in level of this stream, which undergoes changes of nearly 50 ft. from flood to low water, the designers of the station early abandoned this source and have had recourse to a remarkable water-bearing basin located 50 ft. below the surface of a large part of the city and seemingly quite independent of the river water.

The present site of Louisville is over the sand and gravel-filled ancient channel of the pre-glacial Ohio River, through the center of which the latter-day stream of the same name is again cutting its way. The water-bearing sands and gravels above referred to lie at a depth of from 35 to 50 ft. below the present street surface and provide an almost inexhaustible supply of water at a uniform temperature of 55 deg. Fahr., winter and summer. These sand and gravel strata are nearly 65 ft. in thickness and are underlaid by the bed rock. Twenty-five years' experience with pumping from this underground basin has shown that it is much more dependable than the varying stages of the nearby river and is well-nigh inexhaustible unless pumped from a restricted area.

The first source of subterranean supply for the Louisville

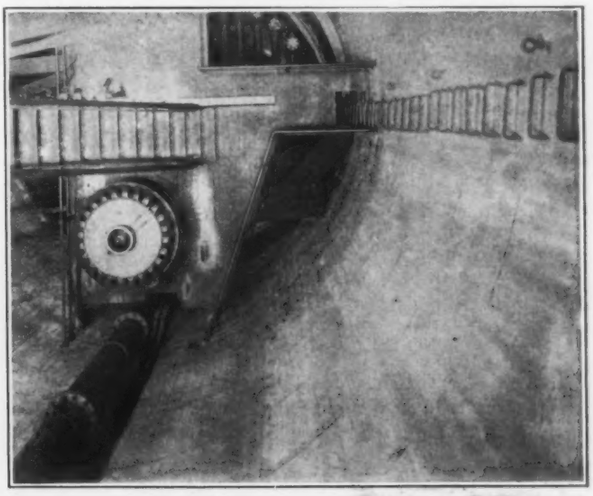


Fig. 1—Looking Downward Into Pump Well of Louisville Lighting Company.

station was an open shaft, lowered below the hydrostatic water level. From this well a pump located in an adjoining shaft delivered its supply to the surface. After other experiments an elliptical brick wall, 56 ft. deep and with axes of 34 ft. and 48 ft. respectively, was put down, from the bottom of which thirty 8-in. tubes each 25 ft. in length were

driven, the last 10 ft. being made up of No. 12 strainers. At the depth at which these strainers are placed they are brought opposite the bedded gravels of the water strata, which thus act as an admirable filter provided by nature for the purpose. All of the thirty well tubes are connected through valves to a common manifold header, from which a

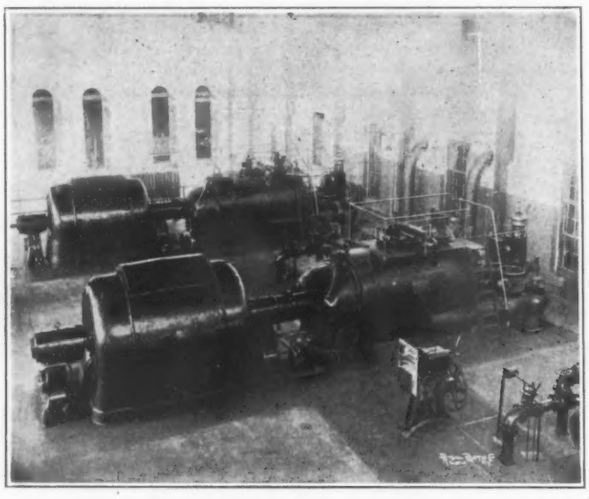


Fig. 2—Two 3000-kw Turbo-Alternator Units in Fourteenth Street Plant, Louisville, Ky.

Gordon compound duplex pump and a Worthington vertical duplex pump deliver 4600 gal. per minute to the condensing-water supply.

Later a concrete well, 60 ft. deep and 25 ft. in diameter, was put down, its bottom reaching 11 ft. below the static water level. From its base twenty-four 8-in. tubes are driven through the sand and gravel, these tubes being alternately 15 and 25 ft. in length and ending in 10-ft. strainers. All of the tubes are connected to a 20-in. header, from which a 16-in. Worthington centrifugal pump, driven by a vertical-shaft, 200-hp Westinghouse alternating-current motor, delivers 5000 gal. per minute against a 90-ft. head. A view looking down into this concrete well from the surface is shown in Fig. 1.

With the increasing requirements of water for the turbine condensing operation of the station, motor-driven impeller pumps have been added, avoiding the necessity of sinking the large and expensive concrete or brick wells. The first of these deep-well pumps installed was in a 10-in. steel tube driven from the surface to bed rock at a depth of 110 ft., and ending in a 35-ft. length of No. 12 strainer. The impeller of this Columbus pump is in eight 10-ft. sections, each carrying three double-bladed impellers. The pump is operated by a vertical 50-hp motor and delivers 1000 gal. per minute. Two other generally similar pumps later installed are provided with No. 40 strainer and are driven by 100-hp motors. They deliver respectively 1350 gal. and 1450 gal. per minute.

With these pumps a total supply of more than 13,000 gal. per minute is thus made available. With the cooling pond and various cisterns now used as a system of reservoirs, a total storage capacity of 500,000 gal. is afforded at the plant.

The turbine equipment of the section comprises two 3000-kw horizontal Westinghouse-Parsons turbo-generator sets, exhausting into Leblanc jet-type condensers, and the latest unit, a 7500-kw Curtis-General Electric turbo-alternator (the largest horizontal unit of this type yet built), exhausting into a Wheeler rain-type jet condenser, similarly the largest of its kind. This condenser is equipped with two tail pumps, one of which can be operated separately on partial loads. Condensing water for these units is cooled during periods of heavy load by spraying through the fifty-six 3-in. Koerting nozzles over the cooling pond, the nozzle pressure being produced by two 100-hp motor-driven centrifugal pumps, each capable of delivering 4500 gal. per minute. Under conditions of partial load the nozzle sprays are not operated, the circulation within the cooling pond itself providing ample cooling, while during the lightest loads of the day it is even found more economical to pump from the wells and waste the water required for cooling purposes rather than to attempt to re-cool it.

While the water obtained from the underground source is excellent for condensing purposes, continuing at a uniform temperature of 55 deg. Fahr. throughout the year, it is found rather hard for boiler-feed use and must be treated before being introduced into the boilers. A mixture of lime and soda is added to the water in four 40,000-gal. tanks, each of which completes the precipitation process in four to six hours and is drawn from in succession. The treated boiler-feed water is then passed through a Cochrane heater, having its temperature raised to 210 deg. Fahr. by the exhaust collected from the various pumps and auxiliaries about the station, and is finally introduced into the boilers by a Terry turbine-driven centrifugal boiler-feed pump, running at 1650 r.p.m. and delivering 500 gal. per minute.

Mr. G. Wilbur Hubley is chief engineer and general superintendent of the Louisville Lighting Company.

CONVEYOR SYSTEMS FOR HANDLING COAL.

Simple Equipments for Unloading Cars Applicable to Small Stations.

By Henry J. Edsall.

A MECHANICAL coal and ash-handling equipment is nearly always included in large modern boiler-rooms, and such equipments have been installed in most of the larger boiler-rooms that were built before conveyors were developed to the point where they were considered part of the regular equipment.

The majority of the small boiler-rooms, however, have been left to struggle along with only the human machine, with his shovel and wheelbarrow, to handle the coal. This is, as a rule, because the owner of the boiler-room does not consider it possible to install a coal conveyor without incurring so much expense that the saving to be obtained would not pay a good return on the investment. In many cases this is a mistake, and an equipment can be found

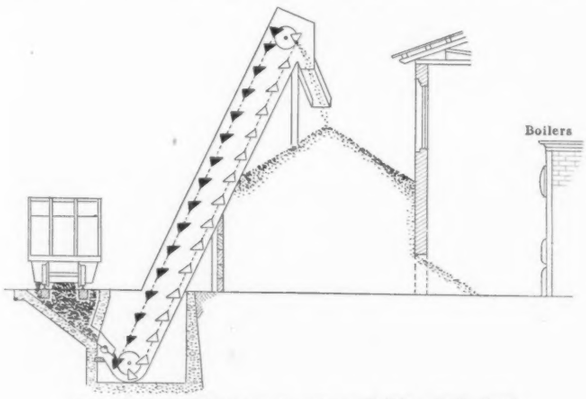


Fig. 1—Coal Elevator for Run-of-Mine Soft Coal.

which will meet his requirements and still be so simple and inexpensive that it will be a good paying investment for him and save him a great deal of trouble and annoyance.

Modern coal cars are nearly all bottom-dumping, and while they are easy to unload in the way that their designers meant them to be unloaded—that is, through the doors in

the bottom—they are troublesome and expensive to unload by shoveling the coal over the side, especially in the large steel cars, or "battleships," as they are frequently termed locally.

Shoveling coal over the side usually means an expense of from 8 cents to 10 cents a ton, and if the coal is distributed along the side of the track it occupies considerable

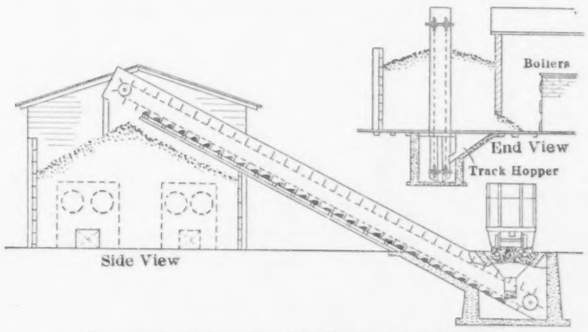


Fig. 2—Coal Conveyor for Boiler-Room Storage.

space, and this, as a rule, means that it has to be rehandled and wheeled into the boiler-room. Where more storage is desired than can be obtained by filling up the space close to the track the coal has to be trimmed back by shoveling or wheeling, or both, and this means more expense. Besides this the demurrage charges for holding the railroad cars longer than a certain time have to be considered, and these charges sometimes add up to a very appreciable sum during a year.

One way to facilitate the unloading of cars is to build a trestle or elevated siding, so that the coal can be dropped on the ground under the trestle. In order to obtain much storage in this way, however, it is necessary to build the trestle fairly high or long, or there will still be trimming required. Also, with a trestle more or less of the coal usually has to be wheeled to the boiler-room, and the farther it is distributed along a trestle the farther it has to be wheeled. If a trestle is built of wood it deteriorates when exposed to the weather, so that at least part of the timbers have to be replaced in eight or ten years, and lumber is becoming more expensive as time goes on. If the trestle is built of more permanent materials it becomes more expensive, and a mechanical equipment will ordinarily be found to be less expensive and more satisfactory.

The illustrations herewith show three simple and comparatively inexpensive mechanical equipments which will handle coal cheaply and satisfactorily. Fig. 1 shows an inclined chain and bucket elevator with two strands of chain and buckets spaced at regular intervals between the chains.

The coal is dropped from the cars into a concrete track hopper underneath the track and fed by means of a regu-

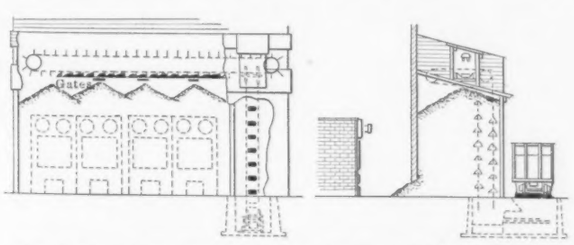


Fig. 3—Coal-Handling Equipment for Run-of-Mine Soft Coal.

lating gate to the foot of the elevator. At the head of the elevator the coal drops into a two-way chute, which distributes it in a bin close against the boiler-room wall. Openings in the lower part of the boiler-room wall allow the coal to go through, so that unless the supply becomes low there is always a pile on the boiler-room floor, within easy reach of the fireman. This equipment is installed in a Pennsylvania electric-light station supplying a community having about 3000 inhabitants.

In this way the coal supply is placed just where it is wanted, and no rehandling is necessary except when the supply becomes low. By making the pile fairly deep considerable storage can be obtained in a compact rectangular bin, and the cost for labor and energy for unloading will probably amount to not over 2 cents a ton. The buckets can be made large enough to handle run-of-mine soft coal, or, if it seems advisable, they can be made smaller and a grating placed over the track hopper, on which the large lumps would be broken by the attendant. This means a cheaper cost of installation but a somewhat higher labor cost in unloading. Where anthracite coal is handled the buckets can be made quite small and a single-chain elevator used.

Fig. 2 shows an inclined flight conveyor handling coal from a track at some distance to a bin close to the boiler-room wall. The coal is fed to the conveyor in the same manner as before, but in this case the buckets are replaced by flights of pushers attached to a single or double strand of chain, and these flights push the coal along in a steel trough and deliver it over the end into the bin. This makes quite an inexpensive type of conveyor, but it is not good practice to run them at an incline greater than about 30 deg. with the horizontal.

Fig. 3 shows a combination of an elevator and a horizontal flight conveyor, which distributes the coal in a somewhat longer bin along the boiler-room wall. The elevator in this case is of the gravity discharge type, with V-shaped buckets at intervals between two strands of chain. The buckets elevate the coal, and then as they turn and travel a short distance horizontally the coal falls out into the flight conveyor running at right angles. The flight conveyor discharges the coal into the bin through doors spaced at intervals in the bottom of the trough. In this case there is also a reciprocating feeder to feed the coal automatically to the foot of the elevator. This feeder consists of a plate which forms a bottom for the track hopper and to which a reciprocating motion is given by means of a crank and connecting rod. The coal moves forward with the plate and subsequently falls over the end when the plate moves back.

An equipment similar to one of those illustrated, or some modification of one of them, can usually be designed to suit almost any small boiler-room, and such equipments are likely to prove a money-making investment and a great convenience.

IMPROVING FIRE-ROOM EFFICIENCIES.

Details of Boiler-Room Equipment at Rockford, Ill., for Economical Generation of Steam.

PROBABLY no plant of its size in the country is as completely equipped for the analysis and record of fire-room operation as the newly reconstructed steam station of the Rockford (Ill.) Electric Company. Draft, feed-water input, proportion of CO_2 and flue temperatures are all matters of continuous record in this plant, and each adjustment by the firemen with changes of load is made with careful regard to stack pressure, CO_2 and feed-water as shown by the indicating devices in the fire-room. Mr. F. H. Golding, manager of the Rockford company, realizes, like many other progressive operators, that the greatest opportunity for improved plant economy exists in the fire-room and has set about to discover and put an end to the many insidious wastes which in the end react upon the coal pile.

The Rockford plant contains 10,000 kw total rating in three horizontal Curtis steam turbines and 1500 kw in

reciprocating engine-driven machines, besides 1500 kw in waterwheels.

Each of the five 500-hp Stirling and six 500-hp Heine boilers is equipped with both a draft gage and a feed-water valve indicator mounted on its front, as shown in Fig. 1. The draft gages, which are of the Westover float type, indicate to hundredths of an inch the complete circular arc

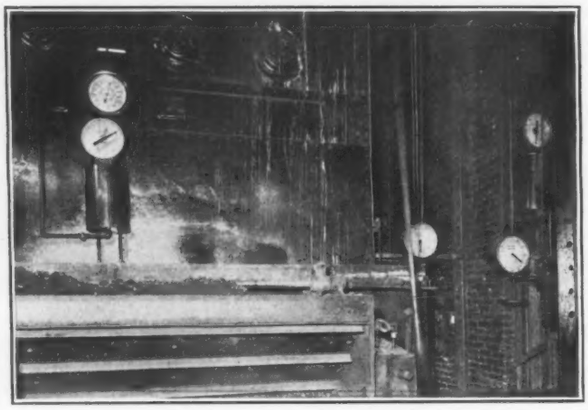


Fig. 1—Boilers Equipped with Draft Gages, Feed-Water Indicators and Steam Gages.

representing about 0.65 in. of water column. The feed-water gages comprise simply pointers connected through gear trains to rack segments on the boiler-feed valve extensions. These are set at zero when the valves are closed, and their indications when open are to an arbitrary scale proportioned to the rate of feed-water input. After a little experience these arbitrary settings become significant to the firemen, showing them just how much water is entering each boiler.

Behind one pair of the Heine boilers a Sarco continuous carbon-dioxide analyzer has been installed, although this set can be transferred to any other pair of units desired. This Sarco apparatus draws a continuous curve of the CO_2 ratio present in the flue gases, and by inspecting the curve sheet from time to time the firemen set their draft dampers as shown by the gages to obtain complete combustion without admitting surplus air. Definite relations have been determined between boiler load, thickness of fire and stack draft, and conditions of best combustion are thus reproducible at any time. To improve further the operation of the furnaces, care has been taken to close up all air leaks into the settings, and the fire doors are opened only the minimum amount necessary for inspection.

To show the fire-room employees the load on the turbine and engine units, a face-plate arm is moved over a row of contacts on the switchboard gallery, lighting lamps behind corresponding transparent numbers in the boiler-room and thus indicating the load in steps of 500 kw each. When an additional unit is to be started up the switchboard operator lights a red lamp on the boiler-room signal panel, giving the firemen a few minutes' warning and often enabling them to carry the extra load by readjusting the boilers already in service.

In the office of the chief engineer of the plant, located in the engine-room building and nearly 150 ft. distant, are installed an Orsat CO_2 sampler for testing the gas from each furnace, a flue-temperature thermometer which can be connected to any flue, a recording Venturi water meter, a steam-pressure gage, etc. These devices are shown in Fig. 2.

Sampling tubes from each boiler lead to the Orsat apparatus, and through these tubes, to insure fresh samples, gas is continually being withdrawn from the flues. The samples of gas to be tested are collected in liquid-immersed metal tanks, which are thus filled at a uniform rate during eight hours by a small motor which lowers the liquid in its counterweighted reservoir. This motor, which runs at 1700 r.p.m., has its speed reduced through a ratio of 1 to 720,000 by worm gears. As the contents of each tank are analyzed in turn, an average eight-hour record is obtained of the CO_2 present in the gas from the corresponding boiler. Compressed air is available for cleaning the sampling device and has been found of much service for keeping the pipes clear and in condition.

Each flue is also equipped with a thermoelectric couple whose emf is arranged to actuate a millivoltmeter, calibrated as a thermometer to read from 75 deg. to 1000 deg. Fahr. By means of fourteen switches this Wilson-Maelen pyrometer can thus be made to indicate the flue temperatures of any of the boilers in the adjoining building. The flue temperatures are ordinarily run at 500 deg. Fahr., and if there is a marked departure from this value, the cause of the trouble, such as baffles down, etc., is at once investigated. With the aid of the pyrometer a close check can thus be kept at all times on the operation of the furnaces and boilers.

The 5-in. Venturi water meter has a capacity of 230,000 lb. per hour, and is equipped with indicating, recording and curve-drawing attachments.

A feature of the operation of the Rockford plant is the daily record curve sheet in the engineer's office, on which are entered in the form of curves the load factor of boiler units, load factor of engine units, pounds water per pound coal, pounds coal per kw-hour, per cent CO_2, flue temperature, average; vacuum carried, back-pressure, and feed-water temperature.

The curve chart has space for the entire month, and all the quantities are so plotted that an improvement in operation in any particular is indicated by a rising slope of the corresponding line, so that the trend of the plant performance is apparent at a glance. A clerk prepares this record and relieves his chief of all detail in this connection. A daily record of the CO_2 ratio is also posted in the fire-room to stimulate the employees there.

As the result of the care taken in firing, the CO_2 content has been raised from 4 per cent and 6 per cent to a sustained average of 10 per cent, representing a saving of several hundred dollars per month. The Rockford steam plant is now producing a kw-hour on from 3.2 lb. to 3.6 lb. of coal, the steam turbines being operated for the major

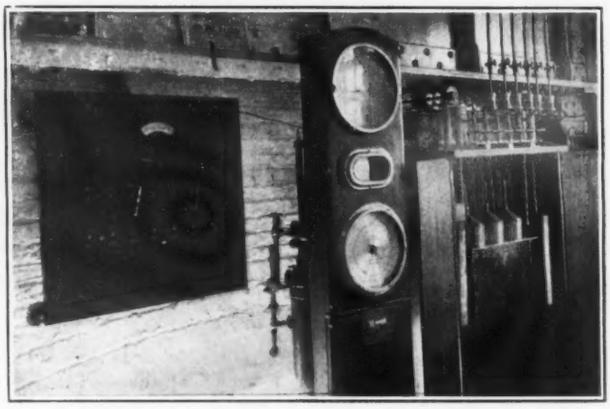


Fig. 2—Flue Pyrometer, Venturi Meter and Orsat Flue-Gas Sampling Machine.

part of the output. Reclaimed coal, dropped from the grates, is used for banking the boilers, effecting considerable saving in fuel. But the local company is not yet willing to rest in the contemplation that all possible has been accomplished and expects that further experience with its complete indicating and recording equipment, now installed only a few months, will result in drawing attention to other possible savings in the operation of the boiler-room equipment.

LETTERS ON PRACTICAL SUBJECTS

OPERATING HIGH-EFFICIENCY UNITS ON REDUCED VOLTAGES AT LOW ENERGY COSTS.

Recently the writer was charged with the purchase of the lamps for an installation where the electrical energy was furnished free of charge under the terms of the rental contract, so that the cost of energy consumed by the lamps was negligible. The first conclusion reached was very naturally to make a selection of carbon-filament lamps, since these 16-cp units cost only 16 cents apiece, while even a graphitized-filament lamp would cost 21 cents and the other higher efficiency lamps seemed out of the question.

I determined to look further, however, at the relative lives of the different kinds of lamps in terms of their first cost, as the thought occurred to me that perhaps a saving could be effected by buying the more expensive lamps if these could be operated to give a correspondingly longer life. The 16-cp carbon lamps would have a life of only 700 hours, but the 60-cent 25-watt tungstens were rated at 1700 hours at their lowest labeled voltage. Operating these latter lamps at 4 volts below the minimum rating, however, would insure a life of 2300 hours, making the tungstens renewal cost practically the same as that for the carbon lamps. A point to be watched and taken into account, of course, is the reduced candle-power of the high-efficiency units when burning below voltage, and such units should be chosen sufficiently large to give ample light when run at the lower voltage. Such a tungsten installation, however, still has the advantage of being very much more efficient than the old carbon lamps, and the true conservationist will enjoy the satisfaction of knowing that he is not wasting energy, but is putting his free electricity to the best use. Of course, the expensive high-efficiency incandescent lamps should not be used where there is danger of breakage or other damage other than natural "burning out" with long life. The same principle of using the higher-efficiency longer-hour lamps at lower voltage may also be applied to equivalent graphitized-filament and tantalum lamps, as well as to the tungsten.

Perhaps the most significant interest of such an installation operating on free electricity is the light thus thrown on the economy of high-efficiency units in all cases where the energy cost is low. Many will be surprised to learn that even with free energy the more costly high-efficiency units are in the end cheapest when operated as I have outlined.

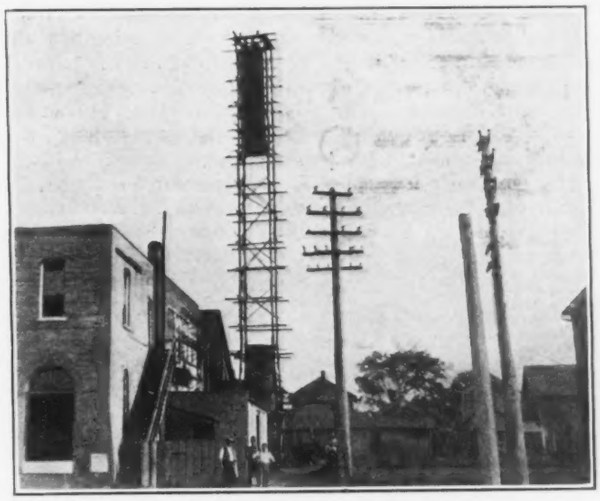
Milwaukee, Wis. MALCOLM L. JONES.

UNIQUE REPAIRS TO A BOILER CHIMNEY.

Electric service for the citizens of Blue Island, Ill., a suburb of Chicago, as well as the water pumping for the town, is supplied by the Sanitary District of Chicago, which has installed one of its substations in the Blue Island municipal plant. The original equipment of boilers and engines is still maintained, however, to serve as an auxiliary in case of interruption to the hydroelectric energy transmitted 30 miles from the Lockport power plant on the Drainage Canal.

The steel smokestack of the Blue Island plant is 100 ft. high and 6 ft. in diameter and was installed twelve years ago. About two years ago the five top sections of the stack began to show evidences of deterioration and were replaced with new sections. During the summer of 1911, however, seven sections lower down on the original stack similarly began to give signs of weakening, and it was determined to replace these.

The five good sections at the top of the stack weighed more than 800 lb. each, and to have torn down the entire structure in order to replace the intermediate sections would have required handling these good sections twice. Accordingly the contractors, the Chicago Bridge & Iron Works, adopted the plan of erecting a scaffolding, as shown in the picture, to hold the good sections in place while the damaged parts were being renewed. The scaffolding consisted of four 6-in. by 6-in. uprights, braced with 1-in. by 6-in.



Repairs to a 100-ft. Stack at Blue Island, Ill.

crossbars, and the total weight which it supported exceeded 2 tons, held at a height of 100 ft. in the air. About fourteen days were required to complete the exchange of sections, and the plan adopted proved an entire success.

La Grange, Ill. M. C. HOLMES.

PARALLELING TRANSFORMER BANKS ON STAR-DELTA SYSTEMS.

An interesting condition arises when it is necessary to connect in parallel two transformer banks operating on a star-delta system. Assume a case where there is a star-connected transmission system and it is required to install a bank of three transformers to feed into a delta distributing system. Fig. 1 shows the various connections which may be made, while Fig. 2 shows diagrammatically the two different phase relations produced by these connections.

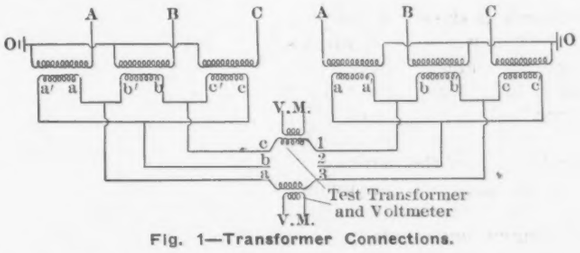


Fig. 1—Transformer Connections.

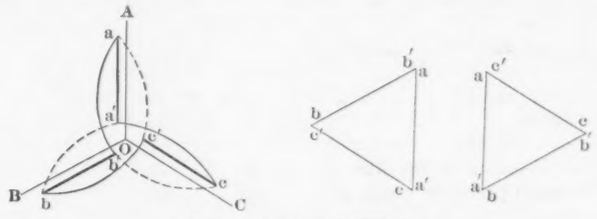


Fig. 2—Voltage Relations.

It will be noted from Fig. 2 that the two different deltas produced will not parallel, regardless of what combination of leads is made. These two deltas are produced by either

a "right-hand" or a "left-hand" connection of the primary coils, or by the two possible connections of the secondaries.

Where the transformer banks to be paralleled are of the same type, and it is possible to trace out the connections of both the primaries and the secondaries and make exactly duplicate arrangement of connections, there will be no danger from throwing the two banks together without making preliminary tests. But if it is impossible to trace out the connections, on account of the leads being brought out underground, or if it is required to connect in parallel with transformers in a distant substation, a "phasing-out" test must be made. For this test two shunt instrument transformers, of the same voltage as the secondaries of the main transformers, and two voltmeters should be used. For convenience in making this test the three leads of the two lines to be paralleled should be tagged *a, b, c* and 1, 2, 3 respectively. By testing out the various combinations of leads as shown in the accompanying table, it can be quickly determined whether proper connections have been made for paralleling.

TRANSFORMATION COMBINATIONS.

1 2 3 *a b c*	1 2 3 *b c a*	1 2 3 *c a b*
1 2 3 *c b a*	1 2 3 *a c b*	1 2 3 *b a c*

This table shows the six possible combinations, the tests being made by connecting one testing transformer from 1 to *a*, the other from 2 to *b*, or 3 to *c*, etc.

If all of the above combinations are tested out without finding one which gives "no voltage" between the respective leads, it is obvious that the two transformer banks will not parallel, and the connection on one of the banks will have to be reversed according to Fig. 1.

The new connections having been made the series of tests, as shown in the table, should again be made and one of the combinations will be found which will give "no voltage" across the three respective leads.

Two testing transformers are necessary, as there are certain of the combinations of leads which will give double line voltage, which will cause both voltmeters to show full voltage.

Los Angeles, Cal. R. E. Cunningham.

TRANSFORMER CONNECTIONS.

In the first issue of October, 1911, a letter appears, "A Transformer Misconnection," from Mr. R. J. Jenkins,

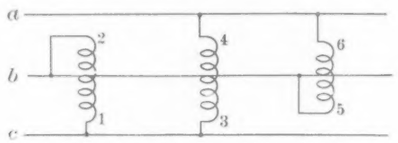


Fig. 1—Delta Connection.

which appears to call for comment for the benefit of those whose experience in transformer connections is limited.

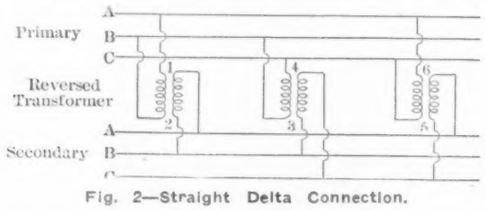


Fig. 2—Straight Delta Connection.

The diagram in his article (here reproduced as Fig. 1) is given to illustrate the misconnection, and is followed by the statement that the connection was made because it happened to be the shortest distance between transformer terminals and the busbars. But this arrangement of transformer is advantageous in constructive work and is used in many installations.

In contradistinction to Mr. Jenkins' reasoning he would

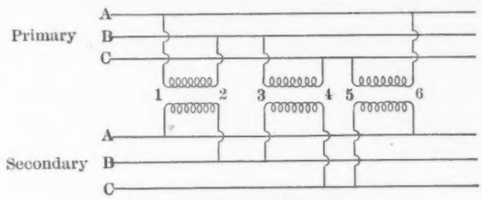


Fig. 3—Modified Connection.

have experienced no circuit-breaker trouble had he simply reversed the secondary of the transformer whose primary had been reversed by the short connection.

The diagrams of Figs. 2 and 3 are given to show there is no difference between using a straight delta connection and reversing one transformer, provided the secondary is correspondingly reversed.

Denver, Col. Vernon R. Marshall.

PRACTICAL METHOD FOR TESTING SOILS FOR FOUNDATIONS.

Probably there is no incident which so utterly disgusts the engineer of a central generating station as the settling of a foundation. A crack developing across one corner of the front of the building is bad enough, but the cracking of a generator foundation or the slow settlement of one side or corner is probably the most exasperating problem with which the engineer is called upon to contend.

It is very easy to test the soil upon which it is proposed to place a foundation. The entire operation is very simple and, as shown by Fig. 1, is easily applied without the use of special apparatus. It will be assumed that the trench has already been dug to the depth of the proposed foundation, as shown by Fig. 1. Drive two or more stakes at least 3 ft. long in the corners of the trench at least 3 ft. from the spot where the test is to be made. The stakes should be driven nearly level with the bottom of the trench and the tops accurately leveled.

Next a timber 12 in. square is placed on end and a mark made at the bottom of the timber level with the tops of the stakes, as shown at *c*. The upper end of the timber is fitted with a platform, built to touch against the guide timbers in the sides of the trench, or the timber may be supported in a vertical position by means of several light guy cables.

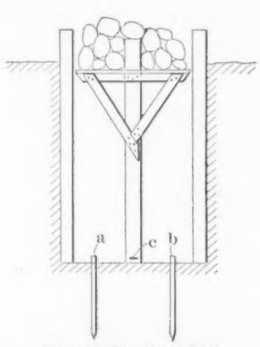


Fig. 1—Testing Soil.

The platform is then loaded with stone, sacks of dirt or any other heavy material available. The material is weighed as it is added to the platform.

Load is added to the platform until the timber begins to sink into the ground. Its sinking is shown by the line *c*, Fig. 2, dropping below the level of the stakes. When this

happens it is obvious that the load-carrying capacity of that particular soil has been exceeded. Should there be a load of 4 tons on the timber it is obvious that the actual load placed upon the foundation should never equal 4 tons to the square foot. But it has been found that a timber 1 ft. square will settle under a load which will not affect a

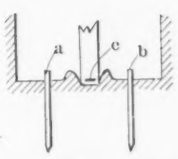


Fig. 2—Effect of Overload.

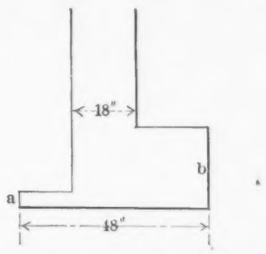


Fig. 3—Depth of Footing Required.

similar load per square foot under a large foundation. That is, the large foundation will safely carry more per square foot than will be sustained by a single square foot of the same soil. Therefore any load per square foot which will not settle a 12-in. by 12-in. timber endwise into the soil may be safely placed upon the footing of a wall. This means that if the test timber will carry 2 tons the footing may also be loaded to 2 tons per square foot and the margin of safety will be sufficient.

Next borings should be made in the bottom of the trench to determine if the soil is of the same character immediately below the bottom of the trench. Ordinarily, borings from 4 ft. to 6 ft. will be ample, but for very heavy work much deeper borings may be necessary. It will usually be found that clean sand and gravel are good for 3000 lb. to 8000 lb. for the former and 6000 lb. to 8000 lb. for the latter. This means from 1½ tons to 4 tons to the square foot, according to the nature of the sand and gravel in question.

Soft clay may be depended upon to support a load of 2000 lb. to 4000 lb.; medium hard clay from 4000 lb. to 8000 lb., and hard, dry clay from 8000 lb. to 10,000 lb. to the square foot. Soft, semi-liquid soils are very hard to estimate. They will sustain loads varying from 500 lb. to 1500 lb. per square foot, and for heavier loads they should be removed entirely or filled with stone, wood piling or sand piles until the test proves that the bearing capacity has been increased to a satisfactory figure.

The next step toward securing a foundation which will not settle is to calculate with exactness the load to be supported by the wall, including, of course, its own weight. Assume, for example, that a certain 18-in. wall must carry a load of 16 tons per linear foot in a soil which tests show to be able to support 2 tons to the square foot. How wide must the footing be made that no settling shall ever occur? A load of 16 tons to the square foot in a soil capable of carrying 2 tons will obviously require a footing 4 ft. wide. The wall is 18 in. wide, leaving 30 in. projection of the footing, or 15 in. on either side of the wall.

Next the thickness of the footing must be determined. As shown by Fig. 3, if the footing be made very thin, as shown at *a*, it will break at the point where it joins the body of the wall. If, on the other hand, the footing be made very thick, as at *b*, a waste of material is the result without the footing being made any better thereby. It has been found that the greater the load per square foot the thicker the footing must be; or, if it be a stepped footing, the steps must be made narrower as the weight per foot increases.

The following table is in use by competent authorities for ascertaining the width of offsets under the loads commonly used, that is, from 0.5 ton to 3.5 tons per square foot:

Applying this table to the problem, it is found that with a load of 2 tons to the square foot the offset, if made of 1:6 concrete, must not be more than 0.95 of its own thickness. Therefore, to project the footing 15 in. its thickness must be 15 ÷ 0.95 = 15.78 in., a little more than 15¾ in. The 1:9 concrete requires a deeper footing on account of 1:9 concrete possessing less strength than the 1:6; therefore

RATIO OF OFFSET TO THICKNESS OF CONCRETE FOOTINGS.

Kind of Bon-crete.	PRESSURE ON BOTTOM OF FOOTING, TONS PER SQUARE FOOT.						
	0.5	1.0	1.5	2.0	2.5	3.0	3.5
1:6.....	1.9	1.35	1.10	0.95	0.85	0.75	0.70
1:9.....	1.4	1.00	0.80	0.70	0.16	0.55	0.50

the 1:9 concrete footing should project only 0.7 its depth. Hence the necessary thickness is 15 ÷ 0.7 = 21.28 in. By following this rule with plain concrete footings one may be sure of making the footings of sufficient strength and without waste of material.

The above rule is so simple that it may easily be followed by any man who knows enough to use concrete, and its use will give results much more desirable than the hit-and-miss method of guessing at the width and depth of footing offsets. For reinforced-concrete footings, of course, an entirely different set of calculations is necessary. It is evident that a much thinner offset may be used, thereby resulting in a great saving of concrete, but at the expense of an outlay for metal and for labor of fabricating and placing it. The rules for calculating the size and strength of concrete reinforcing are so complicated that it is not possible to give them here.

Willoughby, Ohio. JAMES F. HOBART.

SUPPORTING MOTORS ON CONCRETE BUILDING CEILINGS.

Reinforced-concrete industrial buildings are now so common that the progressive contractor should be familiar with the best methods of installing motors in them. It is conceded that the best location for a motor of a capacity of less than, say, 50 hp is on the ceiling. There it is out of the way and does not occupy floor space. Modern induction motors require so little care, if they are intelligently selected, that they can readily be given such attention as they require even if they are mounted overhead. A good induction motor does not require much more consideration than a shafting hanger. It is the purpose of the writer, then, to describe some methods of mounting motors on ceilings of concrete buildings.

As a rule motors inverted at ceilings are held from stringers of some sort. Either timbers (Fig. 1) or structural steel sections (Fig. 2) can be used for stringers. Wood is cheaper, but introduces combustible material in what might otherwise be a fireproof installation. Wood also shrinks and swells. This results in loose bolts, vibra-

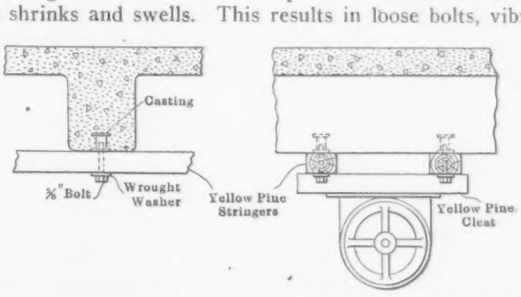


Fig. 1—Wooden Stringers Supported from Spool Casting.

tion and noise. However, wood is largely used because it can always be readily obtained and can be erected by any carpenter. Although somewhat more expensive than wood, structural steel members constitute ideal stringers. When firmly bolted into place they stay there. If an in-

stallation is properly laid out it is not necessary to drill the channels or other sections forming stringers. They can be clamped into place, as suggested in Fig. 2, without drilling. A discussion of methods of mounting motors is really one of supporting stringers, as after stringers of any reasonable design are in place the motor bed-plate can be bolted to them. Either steel or wooden stringers can be supported by the devices described herein.

In the usual concrete building the ceiling is divided into bays by beams that extend down from its surface. Stringers are most often supported from the beams, as suggested in the illustrations, but are sometimes clamped to the floor slabs between beams. The initial step, then, in erecting a stringer is to arrange some method of attaching to the beams the bolts that are to support it. If foresight has been exercised, provision for supporting bolts will have been made during the erection of the building. Otherwise the installer must drill holes in the concrete to accommodate the bolts.

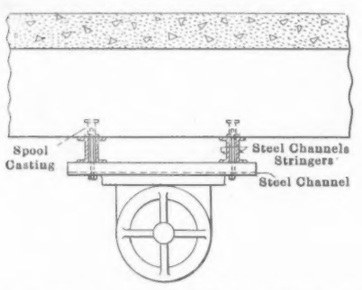


Fig. 2—Structural-Steel Stringers Supported from Steel Casting.

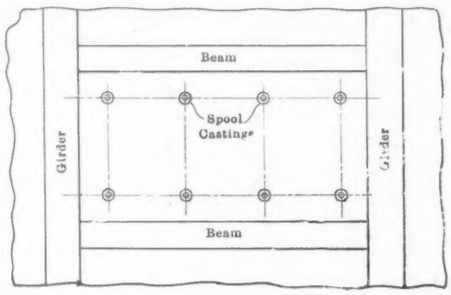


Fig. 5—Spool Castings in Ceiling.

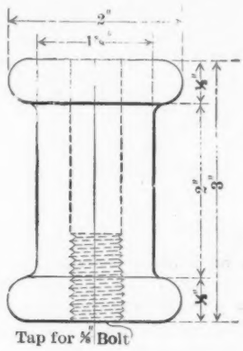


Fig. 6—Details of Spool Casting.

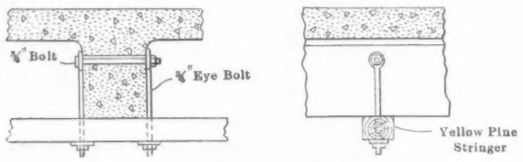


Fig. 3—Eye-Bolts Supporting Stringers.

Figs. 3 and 4 show methods of attaching bolts to beams of concrete buildings wherein no provision for bolts was made at the time the building was erected. It should be noted that in both of these examples ¾-in. round stock is used for the holes. Bolts of smaller diameter are not trustworthy for supporting the loads ordinarily encountered in practice. Also there is a possibility of a bolt smaller than ¾ in. diameter being twisted asunder when a nut is tightened with a wrench in the hands of an able-bodied wireman. In Fig. 3 a horizontal hole is drilled through the beam and through it is passed an ordinary bolt which supports an eyebolt on either side of the beam. The eye-bolts support the stringers. Where one bolt will safely sustain the load an L-bolt, similar to that shown in Fig. 7, can be used instead of the through bolt and the two eye-bolts. In Fig. 4 slanting holes are drilled in the beam side, in which hook-bolts engage. The hook-bolts are merely pieces of round stock threaded on one end and provided with a nut and bent to an angle of about 60 deg. to form a hook at the other.

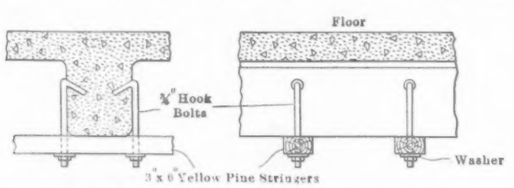


Fig. 4—Hook-Bolts Supporting Stringers.

In drilling holes in concrete an air drill or an electric drill will be found profitable if there is much drilling to be done. If such an investment is not justified, the ordinary rock drill (Fig. 8), which resembles a cold chisel except that it is longer and has a greater angle between faces at its cutting edge, is the best tool to use. Such a drill can be readily forged from tool-steel stock by a blacksmith and so tempered as to maintain its cutting edge for a maximum period. Note (Fig. 8) that the cutting edge of the drill is forged slightly wider than the stem to provide clearance. In using the drill its head is pounded with a hammer and the drill is turned a portion of a revolution between each blow to make the hole cylindrical and to prevent the drill from wedging in it.

In modern concrete industrial buildings, as above suggested, some provision is usually made during construction so that pipes for heating and sprinkler systems, shafting stringers and electrical conduits can be supported without its being necessary to drill the concrete after the building is completed. One method of making such provision is to cast in the concrete ceilings, as shown in Fig. 5, cast-iron spools such as that detailed in Fig. 6. Where these spools are inserted stringers can be bolted to them, as shown in Figs. 1 and 2. These illustrations show the spools set in beams instead of in floor slabs. For stringers the beam location is preferable because with it an unbroken line of stringers can be erected the entire length of a building. Cutting of the stringers into lengths to fit the spaces between beams is avoided.

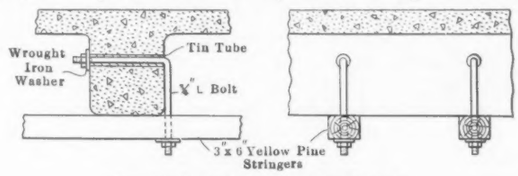


Fig. 7—L-Bolt in Tin Tube Hole.

Fig. 7 illustrates another method of preparing concrete beams for the reception of bolts. A sheet-iron tube is cast in the concrete at each location where a support point is desired; then the stringers to support a motor can be held by either an L-bolt (Fig. 7) or a through bolt and two eye-bolts, as in Fig. 3.

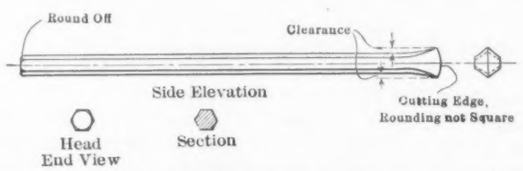


Fig. 8—Drill for Concrete.

Nashville, Tenn. C. G. Jasper.

QUESTIONS AND ANSWERS

We operate motors on 60-cycle, three-phase, 600-volt circuits, and in some of the oil switches which receive hard service there is a heavy black sediment, requiring the oil to be changed quite frequently. After the oil has been filtered, is it suitable for use again in the tanks of the switches, or has it undergone any change due to the arcing which will render it unfit for further use? C. E. S.

Oil for circuit-breakers can be used over again many times provided it is first well filtered. Care should also be taken to remove the moisture in the oil, this being fully as injurious as the carbonized particles. Oil in switches should be inspected frequently, as the apparatus is liable to be damaged in case several severe short-circuits occur in quick succession when, as a consequence, the sediment has not had time to settle. It requires several hours for carbonized particles to settle to the bottom of the switch tank, and during this time the effective insulating qualities of the oil are impaired.

Kindly inform me what electrical apparatus is rated in kilowatts and what in kilovolt-amperes, and why. C. H. T.

The ratio between the kilowatt rating and the kilovolt-ampere rating of electrical apparatus is the power-factor. In apparatus having a power-factor which is nearly unity the difference between the kilovolt-ampere and kilowatt rating is usually ignored, and the apparatus is rated in kilowatts. In direct-current apparatus the power-factor is always 100 per cent, so that direct-current apparatus is uniformly rated in kilowatts rather than in kilovolt-amperes. In view of the fact that in alternating-current apparatus the power-factor is practically never 100 per cent, it would seem proper always to rate alternating-current apparatus in kilovolt-amperes rather than in kilowatts. The practice of thus rating such apparatus is by no means universal, some of the manufacturers preferring to rate their apparatus in kilowatts and others in kilovolt-amperes. So far as we are aware, the distinction between the two methods of rating depends more largely upon individuals than upon types of apparatus.

It is desired to construct a transmission line 5 miles long to meet the following conditions, and information on the best method would be welcome. There will be about 60 kw on the line for three hours, 25 kw for nine hours and 5 kw for the rest of the day. The electricity is for lighting a town of 800 inhabitants with no motor load. The potential at the power house is 2400 volts and at the end of the line 2080 volts. The town has been lighted from a gas-engine-driven plant with not over 2 per cent regulation drop. I believe step-up transformers would result in better regulation, but would it be enough to compensate for the expense of the transformers? F. F. B.

We assume that the transmission line mentioned is to be a single-phase circuit. Independent of whether it is single-phase or three-phase, it would be undesirable to use a wire smaller than No. 6 B. & S. gage. This wire has a resistance of, roughly, 2 ohms per mile, so that 5 miles of single-phase transmission circuit would have a total resistance of approximately 20 ohms. With a load of 60 kva and an emf of 2400 volts, the current would be 25 amp. At 25 amp and 20 ohms the resistance emf would be 500 volts, or, roughly, 20 per cent of 2400 volts. This value is somewhat larger than that ordinarily used, but would probably be permissible in the case, provided the voltage at the generator end can be adjusted so as to maintain proper voltage at the distributing end. Probably it would prove advantageous to operate the system initially at approximately 2400 volts, without step-up or step-down transformers, but to insulate the line for 10,000 volts, with the object in view of installing both step-up and step-down transformers, without changing the transmission wires, at a later date when the load increases to a value to justify or demand such a change.

Three transformers connected in delta step down the potential of a circuit from 3300 volts to 80 volts for a rotary converter. The direct-current output of the latter is 125 volts, 240 amp. If one transformer is cut out, what voltage and amperage would be received from the direct-current side of the converter? A. C. H.

The current which a rotary converter will supply to its load will depend solely upon the relation between the voltage at the commutator and the resistance of the load circuit. So long as the converter mentioned maintains its normal emf of 125 volts, the current which it will supply will depend solely upon the resistance of the load devices. However, if the load resistance is adjusted so as to require the normal commutator current of a certain value and the three delta-connected transformers are fully loaded under these conditions, then when one of the transformers is removed the only change that takes place is that the two remaining transformers are considerably overloaded. Each one will be required to carry 173 per cent of its rated load. In order for the two transformers not to be overloaded, it will be necessary to reduce the load on the converter to 57.7 per cent of its normal full-load value.

A motor-generator exciter set consisting of a direct-current motor rated at 500 volts, 1200 r.p.m., 15 hp, direct-connected to a compound-wound generator rated at 120 volts, 11 hp, 850 r.p.m., has given trouble. The generator voltage builds up and remains steady for a short time, but suddenly dies away. This has happened both on very light load and at full load. The field connections have been checked to determine if the shunt and series fields were bucking. When the voltage fails the action is the same as though both generator fields had been opened. Is the trouble caused by running the generator above rated speed? T. O. K.

The trouble with the generator mentioned is, as you surmise, the excessive speed at which it is operated. When a 120-volt generator designed for 850 r.p.m. is excited to give 120 volts at 1200 r.p.m. the magnetization of the field core is very much below the saturation, and hence if the machine is self-excited it will be unstable. In your case either one of two methods can be employed to obtain stability. Either the driving motor can be over-excited in order to decrease its speed appreciably or the generator can be separately excited from the system from which the motor receives its current. Either of these methods will give satisfactory results. However, over-exciting the motor may cause its field coils to become too warm, while exciting the 120-volt machine from the 500-volt circuit will involve a certain extra amount of loss in the additional rheostat in the field circuit.

An electric fan motor is wound for 52 volts, 133 cycles. It has eight poles, each split and possessing a starting coil. There are fifty-two turns per pole in the running field coil, which is composed of No. 17 single cotton-covered wire. The starting coil has forty-six turns per pole. The rotor has forty-three inductors. How may this motor be converted so as to operate on 110 volts, 60 cycles? W. S. B.

If without changing the winding on the machine it is operated at the lower frequency, with the original value of emf, the magnetic density will be 2.2 times the former value and the iron loss will be about 3.5 times as large per cycle. However, the frequency is less, and the final iron loss is only 1.6 times the initial value. By reducing the emf to about 40 volts the loss will be approximately the same as formerly, but the speed will be less than one-half of its former value. In order to double the speed it is necessary to halve the number of poles. The mechanical arrangement of the magnetic path is not such as to permit this change to be made properly, but fair results may be obtained by connecting the pole windings for four effective rather than eight poles. The windings should be connected in pairs for this purpose. Unless the number of turns is increased, the operating emf will be 40 volts. If the machine is to be operated at 110 volts, it will be necessary to use nearly three times as many turns as at present, with approximately one-third the size of wire now used. In any event, the motor will be incapable of carrying as large a load as formerly.

Central Station
Management, Policies and Commercial Methods

HELPING TO RENT WIRED HOUSES.

The Marion (Ind.) Light & Heating Company offers owners its assistance in finding tenants for electrically wired houses temporarily vacant. The company has erected an electrically lighted bulletin board at the side of its office on one of the prominent streets of Marion, where announcements of wired houses are posted at the request of the owners. The following is copied from the sign-board:

"MARION LIGHT AND HEATING COMPANY'S RENTAL BULLETINS.

"The following houses for rent are wired for electric conveniences:

ROOMS.	LOCATION.	RENT.	AGENT.

The only drawback to the usefulness of the plan to prospective tenants in search of quarters is the fact that no electrically equipped house remains posted long on the bulletin board before it is snapped up.

CENTRAL-STATION FOLDERS FOR NEW ORLEANS STREET-CAR PATRONS.

From boxes in its street cars the New Orleans Railway & Light Company is distributing each week about 15,000 folders advertising its electrical service. The little sheets are about half the size of a page of the *Electrical World*, with an equivalent amount of reading matter, and are folded three times to vest-pocket dimensions. Besides notes on electric heating and cooking devices, electric lighting, motor applications, etc., a number of bits of humor and epigrams and a list of current theatrical amusements are introduced to brighten up the text. Mr. W. E. Clement, contracting agent for the company, believes that this method of advertising central-station service will prove of much benefit, since the average street-car patron has nothing else to distract his attention and welcomes the bit of reading matter to beguile his journey. No name has yet been given the little sheet, but a prize of a complete combination home electric outfit, including percolator, toaster, disk stove and iron, is offered to the person suggesting the most appropriate title.

THE FARMER AS A CENTRAL-STATION CUSTOMER.

A word of caution to operators of transmission lines who have applications for service from farmers was offered by Mr. H. W. Bullock, of Eureka, Ill., in a discussion of farm service before the Illinois State Electrical Association Oct. 26. While the farmer wants lamps in every conceivable place where they may be needed, as well as motors for every possible use, he is, as a rule, very economical in the consumption of energy. Many of the farm customers near Eureka have large tungsten lamps on poles in door-yards, barnyards and feedyards, and motors are used for pumping water, grinding feed, sawing wood, elevating grain into cribs and running cream separators, churns, washing machines, sewing machines, fans, etc. A number of customers use electric irons. The Eureka company requires the farmer to bear the expense of secondary-line construction from the transformer to his own house service, the transformers being placed at convenient distribution centers for three or more customers. Nearly all the farms within a mile of the transmission line are now equipped electrically, and Mr. Bullock declares that this business is reasonably profitable where the customers are not too remote from the line.

A GREAT CENTRAL-STATION BUSINESS.

According to the *Electric City Magazine*, which is issued by the Commonwealth Edison Company of Chicago, that company "sells annually one-third more electricity to one-third more consumers for about one-third less dollars per annum than any other central-station concern in the world." The total connected load Sept. 30, 1911, was as follows:

	Kilowatts.	Equivalent in Lamps of 16 cp.
Light	194,149	3,882,984
Motors	149,837	2,996,732
Railway	125,500	2,510,000
Total	469,486	9,389,716

The company operates three principal generating stations and has three reserve generating stations. It has fifty-three substations, sixteen of which contain storage batteries. It has about 148,000 individual customers, the wholesale consumers being principally elevated and surface railway companies. The company employs about 3500 persons and $65,000,000 of capital, represented by stocks and bonds. Five per cent is paid on bonds and 7 per cent on stock, both selling at a premium, the former at about 103 and the latter at about 135. About a million tons of coal is burned annually. In taxes, franchise remuneration, etc., the company pays into the public treasury about $1,000,000 a year.

LAMP RENEWAL ECONOMY WITH TUNGSTEN LAMPS.

The discussion at the recent convention of Railway Electrical Engineers in Chicago on the report of the committee on illumination served to bring out a fact not generally recognized as yet, namely, that the tungsten lamp as at present manufactured is probably a cheaper lamp to use from the standpoint of lamp renewals alone than is the carbon lamp. In other words, leaving out of account the cost of electrical energy, if a consumer wishes simply to use the lamp which will give him the least cost of lamp renewal per 1000 lumen hours, he has only to operate the tungsten lamp at a low enough efficiency to prolong its life to a point where lamp renewals will be less than with carbon lamps of the same candle-power. This does not, however, take into account the possibility of the operation of the carbon lamp at considerably below ordinary efficiency, thus indefinitely prolonging its life. The point is nevertheless interesting as reminding users that tungsten lamps need not necessarily be operated at the high efficiencies ordinarily prevailing at present, and that if lamp renewal cost is to be brought down it can easily be done by operating these lamps at lower efficiencies, thus prolonging their life. Summed up briefly, the present lamp situation is such that all users who have any regard for saving in electrical energy are adopting

tungsten lamps for locations where the lamps are used enough to make worth while the extra investment in lamps and the added danger of lamp breakage by other than electrical causes. The wise user will not put tungsten lamps in sockets which are rarely used where there is danger of breakage, because a few broken lamps will wipe out any other saving.

PAVING BY ELECTRICITY.

About two months ago the city of Leavenworth, Kan., decided to repave a prominent business street, and let a contract for that purpose to a paving firm, which commenced work with a steam engine to run the paving machinery. Complaints from tenants on the street soon followed on account of the smoke, dirt and noise from the engine, and the Leavenworth Light, Heat & Power Company finally induced the contractor to rent a motor for the power service. A 15-hp motor was mounted on a wagon running the paving machine, which moves three times a week; and as the company's lines are on the street where the paving is being done, connection is easily changed to the service wires, the meter and starting box being carried on the wagon with the motor. As the use of the steam engine had delayed the work, working nights was suggested to the contractor, and now twelve 100-watt tungsten lamps on portable poles furnish light for the night work. The contractors are much gratified with the change to electricity and are getting excellent results.

The Leavenworth company has also carried through a plan to make a "white way" of the principal business street of the city. Through Mr. W. C. Duncan, the commercial manager of the company, the merchants were enlisted in the cause, and five-light tungsten poles are now being installed.

MOTOR APPLICATIONS FOR BRICK PLANT.

The Fallston Fire Clay Company, of Bradey's Run, Fallston, Pa., has recently equipped its brick plant with motor drive throughout. The installation when complete will have a total of approximately 325 hp of two-phase, 60-cycle, 220-volt alternating-current motors, which are belted direct to the various machines. The energy is purchased from the Beaver County Light Company, New Brighton, Pa., and is transmitted a distance of about two miles from the main power house in Fallston.

The application of the motors to the various machines is as follows: One mammoth Ohio brick machine, having a driven pulley 7 ft. in diameter by 19-in. face, and one 12-ft. pug mill, having a 4-ft. diameter pulley, 17-in. face, are both operated by one 75-hp, 600-r.p.m. two-bearing motor, with double extended shaft having a 13-in. diameter by 17-in. face pulley for brick machine and 11-in. diameter by 16-in. face pulley for pug mill. This outfit will be duplicated in the complete installation.

There are three 9-ft. Stephenson dry pans having 4-ft. diameter by 17-in. face pulley, operated at 125 r.p.m., driven by one 35-hp, 600-r.p.m. two-bearing motor, pulley 10 in. in diameter by 16-in. face. The elevators are equipped with individual two-bearing motors rated at 7 hp, 1800 r.p.m. One 5-hp motor running at 1800 r.p.m. is belted to a direct-current generator, which furnishes energy for mining machines. One 3-hp motor is geared direct to a triplex pump, which is used to pump water necessary in the brick plant. Later there will be a 25-hp crusher installed near the mine. When the plant is working up to capacity it is expected to turn out 60,000 bricks per day of ten hours.

This installation is considered rather interesting from the fact that in this application the extreme width of pulley and belt on two-bearing Crocker-Wheeler motors is used. If the installation operates successfully it will mean a new limit to pulley and belt width on two-bearing motors. All systems of drive were considered for the installation, including chain, gear and friction, but the belt drive was selected because it was considered the most practical for an installation of this kind.

ELECTRICITY FOR FARMERS NEAR PETERSBURG, ILL.

When it became known that the Petersburg Electric Light Company planned to build a 16,500-volt transmission line to Greenview and Mason City a number of prominent farmers along the way served notice on the company that if they could have the privilege of taking service at the town rates the right-of-way for the proposed line would be furnished free of cost. Thus practically forced into the supply of electricity to neighboring farms, according to Mr. R. H. Abbott, president of the company, arrangements were made to install several step-down transformer substations along the line, reducing to 2400 volts for distribution to the farms. These single-phase, high-tension transformers are mounted in small houses built on 25-ft. poles and are protected only by fuses. Thus far only two such substations have been erected, one feeding a 2-mile, 2300-volt line supplying four farmers, and one a 2-mile line with two farmers. The 2300-volt lines are of No. 6 hard-drawn copper wire carried on 6600-volt porcelain insulators on 25-ft. poles set forty to the mile, and the regular distributing transformers are equipped with both lightning arresters and 2300-volt fuses. All of the transformers, poles, lines, arresters, etc., are owned by the customers, so that the company is without investment on their account. A minimum bill of $2 per month is charged each customer, the regular Petersburg schedule applying for the energy consumed. The farmers seem to appreciate the service and several have gone to some expense to fit up their places with electrical equipment, installing pump motors, fans, irons, bathroom heaters and other appliances.

NOVEL ELECTRICALLY DRIVEN ASH AND DUMP CARTS FOR BOSTON.

The Quincy Market Cold Storage & Warehouse Company, of Boston, Mass., has recently placed in service an electrically driven coal and ash cart which represents probably the first application of its kind in the electric-vehicle field, and a duplicate equipment has been purchased by the Edison Electric Illuminating Company of Boston for ash service. The machine consists of a Philadelphia type of coal or ash wagon of 5 tons capacity, with a front frame carried upon a pair of standard couple-gear wheels with inclosed motors, and a rear or tipping section mounted upon a pair of 60-in. steel-tired wheels without springs. The wheelbase is about 8 ft. 6 in. The front wheels are 38 in. in diameter and are equipped with 5-in. Kelly block-rubber tires, the chauffeur's seat being located somewhat forward of the axle, with steering wheel and controlling apparatus at the front of the platform, permitting the front wheels to be turned 45 deg. The outfit is driven from a battery of forty-eight "National" thin-plate cells having high-bridged jars and bolted frames, the battery being located in a box above the front wheels. The body is tipped by a "Diamond" hand-operated hoist at the front of the wagon. The length of the machine over all is 14 ft., which is the maximum permitted for city coal carts operated in the business center of Boston, on account of the limitations of

space in backing against the curb between the sidewalk and the car track in narrow streets. The cart makes a speed of 5 miles per hour loaded and 7 miles per hour empty. In a haul of a quarter of a mile the machine is already showing substantial economies over horse traction, all charges being considered. The Quincy Market company operates the largest cold-storage system in the world, and it selected the electric coal car only after the most rigid investigation of its capabilities. It is stated that no other existing design of electric or gasoline truck could meet the space limitations imposed by the company.

GETTING AFTER THE IMPROPER METER SETTINGS.

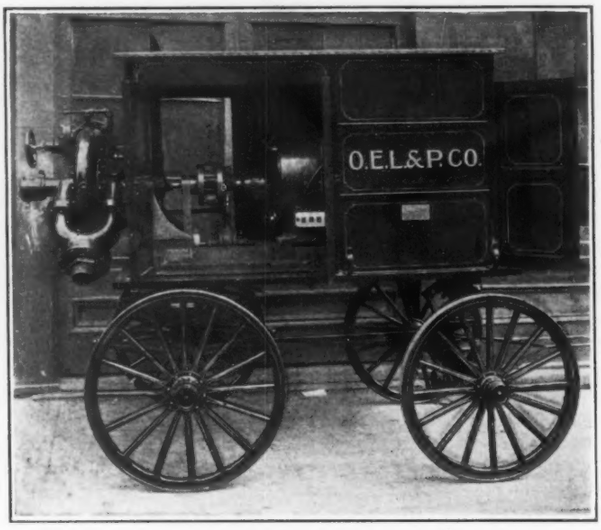
The meter superintendent who halts awhile to make a general survey of the present condition of the meters that have been installed on his system several years is likely to find a surprise waiting for him in the number of settings that were either improperly made in the first place or have become bad examples through neglect or change of conditions in the customer's premises. Meters are located in damp closets and cellars, sometimes even in places where drippings from overhead drains fall upon their cases. In other instances both meters and wiring are in danger of mechanical injury, or the meters are installed in places where vibration causes them to creep. Many meters are located in such inaccessible places that much time is lost by the readers, while it is practically impossible for the meter tester to reach them to make a test on the installation.

A large Western central-station company is now making a detailed house-to-house inspection of its meters that have been installed from time to time during several years, and, needless to add, has uncovered numerous terrible examples of all the things that correct meter settings should not be. Most of these were installed under fairly correct conditions at the beginning, but the customer has allowed that part of his premises where the meter is located to run down or become cluttered up with junk and rubbish, so that an installation test on the meter under the conditions of dirt and moisture prevailing would be out of the question, even if the meter could be reached conveniently. In many such instances the wiring to the meters is also in sad need of repair or may never have been installed with any other idea than that it should be temporary to hold the customer's service for a few days. This fact is usually promptly forgotten and the "temporary" wiring continues in service month after month and sometimes is never changed until the time of some sweeping inspection like that now under way.

A clause in the company's contract requires that the customer shall provide a suitable place and connections for the meter, for which he is responsible. With this as a basis the company has attempted to require customers to have their wiring and meter setting repaired at their own expense. Many properly submit to this requirement, but where the consumer refuses to bear the expense the company puts the installation in repair itself, regarding the cost of doing this as a good investment for the saving of its meter repairs and the time of its readers and testers.

PORTABLE PUMP FOR FREEING MANHOLES OF WATER.

The Omaha Light & Power Company makes use of the portable motor-driven manhole pump shown in the accompanying illustration, energy for which is obtained from the nearest trolley wire. The outfit consists of a 10-hp motor arranged to drive, through a flexible coupling, a small centrifugal pump capable of delivering 100 gal. of water a minute against a suction lift of 15 ft. when operated at 450 r.p.m. The flexible suction pipe-line used for reaching into the manhole is carried in two sections on the brackets shown at the side of the cart. For priming the centrifugal pump at the start the small belt-driven vacuum pump seen



Portable Manhole Pump.

just below the flexible coupling is used. The motor is arranged with a bank of resistors for speed control, enabling adjustments to be made corresponding to the suction lift from which water is to be pumped. Mounted on the rear of the cart is a reel of two-conductor cable which can be run out to connect to the nearest trolley wire and ground-rail return, from which energy is obtained for operating the outfit. The cart with its pumping equipment was built for the Omaha company by Yeomans Brothers, Chicago.

CENTRAL-STATION DRIVE OF ILLINOIS COAL MINES.

Central-station service to coal mines certainly represents the isolated plant tracked and felled in its last lair. The electric companies in the coal fields of central Illinois continue to take on these mine loads, whose off-peak demand makes them desirable load-factor business. The Peoria Gas & Electric Company has recently equipped several coal mines electrically in its vicinity, one of which is unique in employing three-phase locomotives. Unfortunately, however, the State law of Illinois limits the electrical pressure which may be taken into mines at 275 volts, and special transformers were required to give the limiting voltage under this restriction. The mine extends 4000 ft. from the entry, and as each locomotive used is equipped with two 37-hp motors the conductor-drop loss has been considerable.

At the Illinois electrical convention held at Rockford Oct. 26 Mr. J. J. Frey, of Hillsboro, Ill., told of several coal mines operated by his company within a radius of 12 miles of his station. One of these mines had been considered exhausted by the ordinary method of mining, but the electrical operation will extend its life many years. A coal washer driven by 300 hp in motors constitutes another good load for the Hillsboro system. Mr. E. H. Negley, of Canton, Ill., stated that the energy consumption per ton of coal mined he found to average 0.5 kw-hour for hauling, only, of the coal out of the mine by electric locomotive. In a paper read by Mr. W. A. Thomas, of Pittsburgh, Pa.,

on the same subject of motor drive in mines the consumption per ton of coal in a mine completely equipped electrically was stated to be from 0.5 kw-hour to 3.5 kw-hours, averaging 1 kw-hour to 2 kw-hours. In the case of a certain large coal mine cited by the author about one-half of the possible output of 40,000 tons per month was being actually mined. A total of 1450 hp in motors is connected, but the maximum demand of the load reaches only 800 hp. Practically all operations are performed with motors, the pumping of water from the lower levels, however, constituting a large part of load. The coal is loosened by eight 25-hp coal-cutting machines and hauled out by thirteen 15-ton locomotives. A total of 300 hp is installed in pumps. The energy consumption at this mine has averaged from 2.1 kw-hours to 4 kw-hours per ton of coal mined, the high average of 3 kw-hours per ton being due to the large pumping requirements of the mine.

THE "ACTIVE-ROOM" RATE IN ST. LOUIS.

To correct some erroneous impressions in relation to its new "active-room" residence rate (*Electrical World*, Oct. 28, 1911, page 1068) the Union Electric Light & Power Company, of St. Louis, has issued some supplementary explanations which will be of interest to buyers and sellers of electricity. What follows is given substantially in the language of the company:

"First—It is not necessary to have four active rooms, and thereby require that at least 16 kw-hours be consumed per month at the 11-cent rate before the benefit of the low rate of 6 cents is secured. For example, consider a five-room flat, consisting of a living-room, a dining-room, a kitchen, two bedrooms and a bathroom. Three of these rooms, living-room, dining-room and kitchen, are regarded as active, and the first 4 kw-hours for each of these three rooms will be billed at the 11-cent rate, and the excess at 6 cents. The same flat, if the living-room referred to were converted into a bedroom, would have but two active rooms, a dining-room and a kitchen. In this case the first 8 kw-hours would be billed at the 11-cent rate and the excess at 6 cents.

"In the case of a four-room flat, consisting of two bedrooms, kitchen, dining-room and bath, there would be but two active rooms, the kitchen and dining-room. Therefore 8 kw-hours would be charged at the 11-cent rate and the excess at the 6-cent rate.

"Second—We find that some of our patrons have the impression that all electricity consumed in the active rooms is billed at the 11-cent rate, which, of course, is an error. The fact is that the first 4 kw-hours for each of the four or less active rooms, regardless of what part of the house the electricity is actually consumed in, is charged at the 11-cent rate, and all the excess electricity used on the premises, regardless of where it is used, is charged for at the 6-cent rate. The reason for charging for the first 4 kw-hours for each of the first four active rooms is that the lamps in these rooms are more apt to be used simultaneously, and therefore more nearly represent the maximum amount of energy that the customer draws from the company's service at one time and for which the company must make adequate provision. The lamps in the bedrooms, bathroom, basement, attic, etc., are used at odd times, and therefore are not regarded as increasing the demand.

"Third—In the system of rates previously employed the rate was based upon the number and size of lamps installed. Under the new rate the cost of the service is not affected by the number of lamps installed, and it is, therefore, permissible to equip the house with many convenience lamps, such as lamps in closets, additional portables, or decorative lighting, without increasing the charge.

"Under the new rate electric household appliances can be used at practically half the cost compared with the old rate, inasmuch as the energy consumed for lighting will invariably put the consumer on the 6-cent rate. Therefore any additional consumption through the use of electrical appliances will be charged at the low rate of 6 cents.

"In a nutshell, the conditions are as follows: The minimum monthly charge is $1, regardless of the number of lamps or heating appliances in your residence. If you have two active rooms, 8 kw-hours (2 × 4) are billed at the 11-cent rate and the excess at 6 cents. Assuming a consumption of 15 kw-hours, your average net rate would be 8.2 cents per kw-hour, the saving on 15 kw-hours over the old rate being 47 cents.

"For three active rooms 12 kw-hours (3 × 4) are billed at the 11-cent rate and the excess at 6 cents. Assuming a consumption of 20 kw-hours, your average net rate would be 8½ cents per kw-hour. Here the saving on 20 kw-hours over the old rate would be 57 cents.

"If you have four active rooms 16 kw-hours (4 × 4) are billed at the 11-cent rate and the excess at 6 cents. Assuming a consumption of 25 kw-hours, your average net rate would be 8.7 cents per kw-hour. The saving on 25 kw-hours over the old rate would be 66 cents.

"In the foregoing the rates 11 cents and 6 cents, wherever referred to, are, of course, subject to a discount of 5 per cent for prompt payment."

CINCINNATI'S SOLUTION OF THE AUXILIARY-SERVICE NUISANCE.

The usual isolated-plant owner who approaches the central-station manager for standby or auxiliary throw-over service to his plant becomes not only surprised but aroused when he finds that for such readiness-to-serve provision it is proposed to charge at least for the investment in machinery and equipment necessarily reserved for the service. He has probably formed the idea that it is a simple matter for the central station to extend its helping hand to the throw-over clips on his main switch, when needed, and that out of its ample storehouse of energy the big station can furnish almost any amount, more or less, without noticing the difference.

Such a plant owner, according to Mr. J. D. Lyon, commercial manager of the Cincinnati central-station company, is comparable to the man who would object to paying annual insurance premiums until the year his house burned down.

The diversity factor of such throw-over services, Mr. Lyon also points out, is not nearly so high as has been supposed, but is, indeed, very low when the matter of isolated-plant interruptions from general causes is considered. For example, a break in a pipe line may put every gas engine in town out of operation, while a strike of teamsters might have a similar effect on steam stations using coal as fuel. Any such incident would at once throw the entire amount of this class of auxiliary service onto the central station's lines and the company would find that the high diversity factor it assumed had been reduced simply to the diversity factor between the services of the isolated plants themselves.

Accordingly, in the new rate schedule recently put into effect in Cincinnati the plant owner is required to guarantee $36 yearly, or $3 monthly, for each kilowatt of his desired connected demand. Such service is furnished through automatic overload circuit-breakers (furnished at the customer's expense) and set to open at demands exceeding that contracted for. In addition the company inserts in the line its own fuses of a carrying capacity slightly above the setting of the circuit-breaker and for replacing these fuses when blown as the result of an excessive overload makes a charge of $1 to the customer.

Where the isolated-plant owner is willing to accept off-peak restrictions on his throw-over service, agreeing to use no energy between 4 p. m. and 6 p. m., November to February, inclusive, he is permitted to use central-station energy up to an amount equivalent to his guarantee payment without additional cost. Beyond this charge is made at the usual schedule.

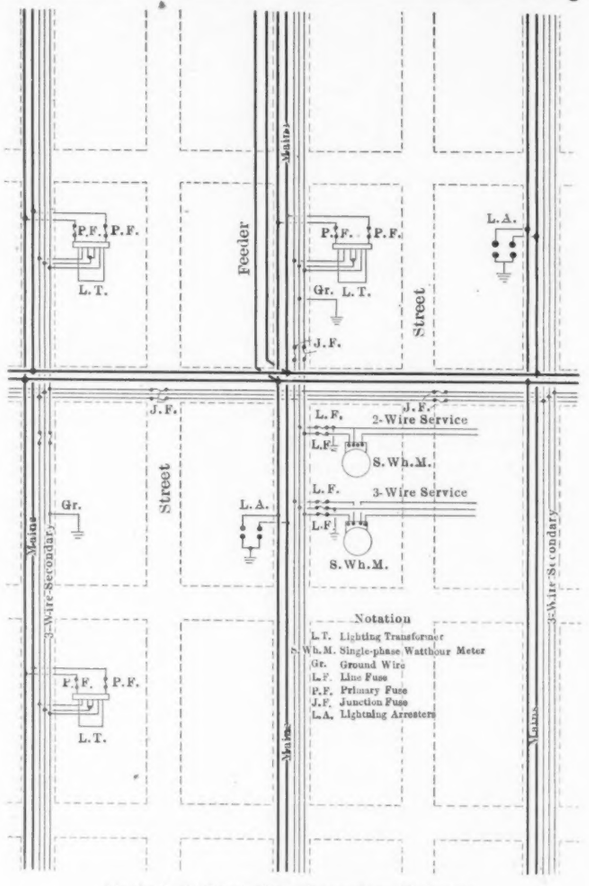
In cases where no off-peak limitations are agreed to by the customer for making his emergency demands the same monthly charge of $3 per kilowatt is made, but in return for this only the use of 30 kw-hours of central-station service for each kilowatt of contracted demand is permitted, all additional consumption being charged for at the regular rates in addition to the service charge.

GROUNDING SECONDARIES AT DENVER.

Among the larger central-station systems which have lately adopted the grounding of secondary lighting networks as a standard feature of distribution practice, that of the Denver Gas & Electric Light Company deserves mention on account of the rapidity and completeness with which the work has been accomplished. The importance of safeguarding the public and its consumers from accidental contact with circuits of dangerous potential has long been appreciated by the management, and in cooperation with the insurance interests and municipal authorities the company has done much in the past few years both to improve the quality of distribution service in older installations and to cast the weight of its influence on the side of better wiring in later applications of electricity to domestic and mercantile lighting. In common with many other central-station organizations, however, the company maintained a passive attitude in regard to the grounding of secondaries until about two years ago, when it was decided to investigate the problem with a view toward adopting the grounding practice. A broad consideration of the subject led the company to begin grounding its three-wire secondary network in the spring of 1910, and by the fall of that year the entire system of distribution secondary circuits was grounded according to a standard plan illustrated in the accompanying diagram.

The Denver Gas & Electric Light Company supplies electricity for lighting and power applications to all the territory within the city limits and to the local companies, manufacturing plants and amusement parks in the suburban districts surrounding the city. Energy is supplied to the distributing system from a main steam plant on the west side of the city, from an auxiliary station known locally as the Lacombe plant and from the transmission system of the Central Colorado Power Company, through a substation receiving energy from the two hydroelectric plants of the latter organization at Shoshone and Boulder. The operating center of the Denver system is at the West Side Station, which is connected with the auxiliary equipment of the company located elsewhere, so that the load may be distributed according to the conditions of service. The lighting service, which is of interest in connection with the grounding practice, is handled by multiple, single-phase, 2200-volt primary feeders and mains, supplying energy to secondary networks throughout the urban district through step-down transformers located at important centers of distribution and feeding individual consumers at 110 volts and 220 volts, according to the local load requirements.

The single-phase alternating-current system is made up of twenty-six two-wire, 2200-volt feeders extending from the station busbars to the electrical center of a definite section of the city which is electrically independent of any other section or feeder. The primary mains extend from the center of distribution in each section in the form of laterals or branches supplying energy to the most remote transformers of the district with the usual inclusion of intermediate transformers bunched, so far as practicable, to secure economy of operation and reasonable first cost. Any feeder may be fed from a special auxiliary bus in the station in case repairs, adjustments or inspection are necessary in connection with the switches and regulators in routine service. Within a given section the secondaries of all transformers are connected by three-wire tie lines forming low-tension busbars from which the leads to the various consumers are tapped. The transformers used on the lighting system vary in size from ½ kw to 50 kw, and all above 1-kw rating are connected for 2200 volts on the primary, each of the two secondary coils being brought out of the case and connected so as to give 110 volts between the middle or neutral line and either of the outside lines and 220 volts between outers. The company has found that with the load well balanced considerable saving



Method of Grounding Secondary Network.

in secondary copper results from this method of operation, as would obviously be anticipated.

Each transformer is connected to the primary main through outside-type primary fuses of double the transformer rating in amperes. The secondary network is sectionalized between each pair of transformers by a set of fuses or junction cut-outs, these being placed approximately at the point of zero current between the adjacent transformers on each secondary interfused section. The object of this fusing of secondary sections is to prevent the transformers on either side of a defective unit or secondary service from assuming heavy overloads. As soon as any abnormal conditions arise the junction fuses on either side of a defective section blow, as well as the primary fuses on the transformers, and the section is automatically cleared from the system. The junction fuses are of copper wire, being about 50 per cent larger than the rating of the smaller of the two transformers between

which they are in each instance placed, and varying from about 60 amp between 5-kw transformers to 400 amp between 50-kw units. No fuses are installed in the neutral lines of the secondary networks, although fuses are placed in all leads running from any wire of the secondary service to consumers' premises.

The company began grounding in the residential district by connecting the neutral of the secondary mains to the nearest water hydrant at intervals of about two blocks. All services enter buildings in Denver from alleys at the rear, through which the primary and secondary mains are carried. The neutral-main ground connection is made by a No. 4 B. & S. copper wire stapled to the pole and covered with weatherproof insulation, the ground wire being run down the pole and to the hydrant at the bottom of a trench 18 in. deep. The alleys are 16 ft. wide and the neutrals are usually carried on 35-ft. poles about 20 ft. above the ground. Approximately 60 ft. of No. 4 wire is usually required for the ground connection in residence districts, the maximum length being 125 ft. The neutral ground wire is attached to the hydrant by the simple process of winding it beneath the footing bolt and making tight with a wrench. In the down-town section the usual length of ground wire required from the secondary network is from 10 ft. to 50 ft. The company has given up the use of the inclosed fuse in its secondary mains on account of the cheapness of open fuses. The total number of grounds made on hydrants by the fall of 1910 was about 150, the work being done with the consent of the Denver Union Water Company, which supplies water for domestic and commercial service within the city. From four to six hydrant grounds can be installed per day by a force of two men. In the residential district the average cost of making a ground was about $4.50, the cost of material coming to $2.50, with labor $2. In carrying out the work of grounding it was found necessary to put the current coils of all meters in the outer leads of the incoming service, in order to protect the company against loss of revenue from accidental grounds in the consumer's house-wiring. No evidence has been found of the disintegration of the hydrant grounds and no perceptible expense of maintenance has been found to exist in connection with the grounding system.

By regulation of the municipal authorities early in 1911 all new electric-lighting installations are required to ground their neutral wires, the owner and wiring contractor being responsible for this work. All wiring in new buildings is required to be in iron-armored conduit, and where possible concealed wiring in old buildings is required to be installed in this manner. The use of inflexible metal conduit is permitted in connection with switch loops and wall outlets, while open wiring is allowed in approved metal molding. Drip loops are provided in conduit where it enters the building. The main switch and cut-out or fuse are required to be installed in a rear room or hallway, where the exit door is located, and all wires in the building are disconnected by this, a plan which obviously is of much value to firemen. The fuses are placed ahead of the main switch in order to protect the latter from short-circuits. The meter loop is taken from below the switch, so that both switch and cut-out protect the meter. The cut-out cabinet or center of distribution is required to be placed on a side wall not over 7 ft. above the floor and away from any grounded portion of the building, such as a sink, radiator or stove. These cabinets are not allowed in clothes closets or bathrooms.

Under the present conduit system the cut-outs are installed in an iron cabinet, the metal of which is 1/16 in. thick, with tight-fitting door. Inclosed fuses are also required. The different circuits branch out from the cut-out cabinet and are connected and held in place by lock nuts on either side of the sheet metal of the cabinet, with an insulating bushing at the end of the pipes to protect the wire covering. The city requires conduit to be permanently and effectively grounded in such a manner that in case either wire comes in contact with the conduit and a ground exists on the opposite polarity it will be able to operate the heaviest fuse before burning off the ground. This ground is usually made by bonding the conduit to the water pipe. Grounding to steam or gas pipes is not allowed. An insulating joint and canopy ring are required to insulate the fixture proper from the conduit. When fixtures or sockets are installed over cement or grounded floors, or in places where they can be reached from grounded parts of bathrooms, stoves, ranges, etc., porcelain sockets are required to insure safety while turning on the lights. The ground wire connecting the conduit with the water pipe cannot be smaller in circular mils than one-half the main feed wire. A special clamp is provided for grounding the neutral wire to the cabinet box and conduit system in the box, just inside the building in each case. The company's experience indicates that, both from the standpoints of fire hazard and safeguarding individuals, the grounding of lighting secondaries up to a point where the maximum potential between any lead and ground does not exceed 150 volts is an excellent precautionary measure.

Wiring and Illumination

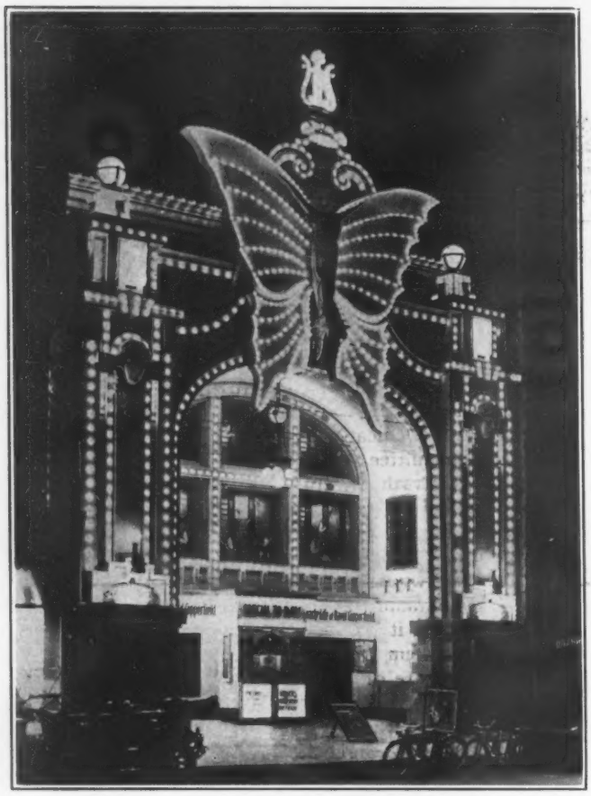
UNUSUAL LIGHTING FEATURES OF A SMALL MILWAUKEE SHOW HOUSE.

The accompanying illustration shows the striking effect obtained at the Butterfly Theater, Milwaukee, when the front is studded with 1800 5-watt, 12-volt tungsten lamps, wired in series multiple. In addition to these standard-base lamps there are 500 others of the candelabra type, used to outline the program cards at the entrance. The effect of these 2300 lamps is brilliant indeed, and rarely fails to arrest the attention of the passerby along Grand Avenue.

Only direct-current central-station service is available in the downtown section of Milwaukee, so that it became necessary to adopt the series-parallel scheme in arranging the small tungsten lamps. The principal objection to this arrangement is, of course, the unbalancing and over-voltage imposed on the rest of the lamps of a group when one of its number burns out. This has been guarded against in the Butterfly installation by extending the wires of each group down to pairs of receptacles in a cabinet on the theater balcony. The lamps on the front are watched closely, and if one is seen to be out another is immediately inserted in one of the two receptacles attached to that circuit, restoring the current per lamp to its normal value. Next day, with a ladder, the burned-out lamp can be renewed, with any others that have been broken. This enables all renewals to be made simultaneously and saves the improper burning of lamps during the time that must elapse before means of renewing the burned-out units are at hand.

The interior of the Butterfly Theater is of unusual size for a moving-picture house and is lighted entirely by the indirect system. The floor measures 120 ft. by 40 ft. and is illuminated by twenty ceiling reflector bowls, each containing seven 60-watt tungsten lamps. Below the balcony are fifteen smaller indirect units, containing four 40-watt lamps each. A Milwaukee city ordinance requires at least "twilight" illumination of the auditorium during moving-picture performances. The indirect units are accordingly arranged on two circuits, one, made up of a single lamp in

each of the balcony fixtures, being operated during the progress of the pictures. Since the intensity of the illuminated wall surfaces is not high compared with exposed units, the presence of this light does not detract from the pictures. The balcony lamps impose a relatively higher intensity at the rear, tapering toward the front of the house,



Exterior Illumination of Show-House.

a distribution which also prevents glare effects in the eyes of the audience.

The lighting was laid out by the illuminating engineering department of The Milwaukee Railway & Light Company, which offers its services free of charge to any architect or owner of a building served by its lines. One of the suggestions of the engineering department was the indirect illumination of the present studded theater front, bathing the whole in distributed light of high intensity, set off by the central butterfly figure in silhouette. This would have made possible the use of standard-voltage multiple lamps and would present so unusual an appearance that it is hoped to carry out the scheme in some future installation.

BOTTLE ELECTRIC TOWER.

Following are details of construction and operation of the remarkable "Bromo-Seltzer" electric tower in Baltimore, a short account of which recently appeared in these columns:

The Bromo-Seltzer Tower building is the highest structure in Baltimore. The tower itself to the top of the roof just under the revolving bottle is 289 ft. 3½ in. high. The bottle and cork is 51 ft. 2½ in. high. The crown is 15 ft. 8 in. high to the top of the cross, with a clearance space of 13 in. between the cork and the crown, making a total height of 357 ft. 3 in.

A central core 13 ft. 2 in. in diameter and 53 ft. high, built in eight sections, and forming part of the steel construction of the whole tower, extends up above the roof of the tower. This core is shown on the accompanying structural drawing and extends up to the base of the crown to take the plates which are part of the crown. The exact dimensions of the bottle are 51 ft. 2½ in. high to the top of the cork and 20 ft. 7 in. diameter. The cylindrical portion of the bottle is 33 ft. high, and this portion revolves. The shoulder and neck of the bottle is stationary.

The revolving part is made in nine panels, in order to carry the letters properly on the outside. The panels are supported by nine bridge trusses each 30 ft. 10 in. long with 7 in. overhang at the top and 19 in. at the bottom and 2 ft. 9 in. deep. Each of these trusses rests against two rollers, one at each end. Two circular tracks are placed around the central core at the ends of the bridge trusses. The nine trusses are connected by cross and angle frames at the inside and outside verticals, making a stiff annular structure with nine sides and nine rollers at the top and nine at the bottom.

The top of the building is in the form of an octagon with eight radial I-beams extending out to the inclined roof. On each of these beams are eight heavy rollers carried in Hyatt roller bearings. A 70-lb. rail bent to a perfect circle rests on these rollers and carries the total weight of the revolving structure. Just inside of the rail is a circular rack made in nine sections, each section having thirty-four teeth, or a total of 306 teeth of 7-in. face and 2-in. circular pitch.

The floor plan shows the driving mechanism, which includes a back-geared, 10-hp, 125-volt direct-current motor. The motor runs at 825 r.p.m., the back gear reducing 6 to 1. The back-gear shaft carries a bevel pinion 5 in. in diameter and 5-in. face meshing into two bevel gears with sixty-nine teeth each. These drive the two shafts in opposite directions. Each shaft has on it a pinion 10 3/16 in. diameter, sixteen teeth, 7-in. face, meshing into the rack on opposite sides, which drive the revolving portion of the bottle around at

Fig. 1—Bromo-Seltzer Tower Building.

1½ r.p.m. While a 10-hp motor is employed, it is found that it takes scarcely 3 hp to operate easily.

The whole bottle is covered with No. 16 galvanized Toncan metal, except the sheets carrying letters, these latter being No. 13 plates. There are twelve letters on the bottle making the words "Bromo-Seltzer." Each of these letters is 10 ft. high and 5 ft. wide. The width of the

lines of the letters, which are made in trough form, is 15 in. The sides of the trough are 4 in. high, being made of the same metal.

A row of 8-cp to 12-cp lamps is placed in the center line of the troughs, making a total of 315 lamps in the letters. The letters are painted white inside; the body of

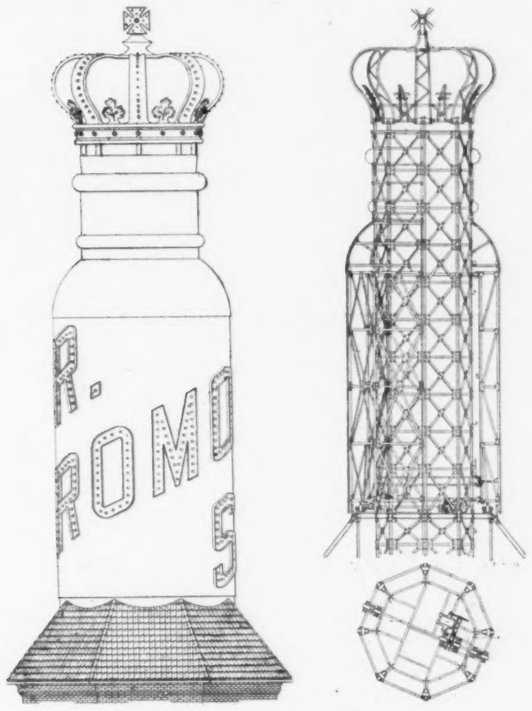


Fig. 2—Elevation and Section of Bottle Sign.

the bottle is painted blue, the same color as bromo-seltzer bottles. For the illumination of the moving structure the main wires are carried up to a switch inside the core. From there the wires lead to two short trolleys secured to one of the vertical columns of the core. Two circular tracks are fastened on the inside of the revolving structure on insulated supports. The trolleys run in contact with the tracks.

Ten cutout boxes are placed so as to serve the letters in each panel, and these are connected to the circular tracks. Leads are run from these cutout boxes to the back of each of the letters and up along the line of the lights. A series of holes is cut through the outside casing sufficiently large to allow the lamps to pass through. The lamp sockets are set in plates secured to the shell of the structure by three screws and thumb nuts. An old lamp can be taken out and a new one inserted in a couple of minutes. The sockets are connected to the lighting wires by flexible cords so that each lamp can be drawn into the inside of the bottle and renewed when worn, thus avoiding the necessity of the workman going on the outside of the structure.

The total weight of the revolving structure is about 15 tons, and when running the movement is so smooth and free that there is no vibration felt on the floors below. The crown is 20 ft. in diameter, 10 ft. 2 in. to top of arches and 5 ft. 6 in. to top of maltese cross. The maltese cross is 3 ft. high and 3 ft. wide. The lower band of the crown is 15 ft. in diameter and 2 ft. 4 in. deep. There are sixteen clusters of five 8-cp lamps in the center of this band, each cluster of a color to represent a jewel, such as a ruby, emerald, etc. Rising from this band there are eight imperial arches 25 in. wide at the base, narrowing to 17½ in. at the top. These arches are made in a rounded trough shape and each contains eighteen 8-cp lamps.

Between the eight arches there are eight fleurs-de-lis, 3 ft. across and 3 ft. high, each leaf being 14 in. wide. In the center there is a cluster of three lights. The maltese cross has twelve 8-cp lamps on each side, with one central cluster of five lights. Various colored lamps are used to get the effect of the various jewels.

The crown is built of copper on a structural iron framework and the whole is covered with goldleaf. The total number of lamps in the crown is 282.

This bottle and crown with its method of illumination were designed by Mr. Samuel T. Williams, of Williams & Shock, Baltimore. The structural ironwork was erected by the Lauer & Harper Company, the sheet-metal work by Vaile & Young and the electric lighting by the Kingsbury-Samuel Electric Company.

THE LIGHTING OF RAILROAD STATIONS.

The present practice in the illumination of railroad stations, approaches, offices, dining-rooms, etc., was discussed in a report of the committee on illumination presented before the Association of Railway Electrical Engineers at the Hotel La Salle, Chicago, Nov. 9. Mr. C. R. Gilman, chief electrician of the Chicago, Milwaukee & St. Paul Railroad, headed the committee, the other members of which were Messrs J. R. Cravath, W. D'A. Ryan, S. W. Everett, C. W. Bender, Richard Hamilton, T. R. Wentworth and B. F. Fisher.

The lighting of station properties, it was pointed out, must be planned with a view to the maximum efficiency consistent with minimum cost of installation and maintenance. In cases, however, it is wise to make a sacrifice in efficiency to provide a system of lighting that will conform to the general architecture of the room. Waiting-rooms and dining-rooms are examples where the esthetic considerations should be given weight in the design.

The spacing and height should be chosen with a view to providing a uniform illumination over the useful working plane and should avoid the placing of units of high intrinsic brilliancy in the direct line of vision, resulting in a disagreeable glare. Local lighting should be provided for by low-candle-power lamps properly equipped with a suitable reflector to screen the light from the observer's eyes and direct it in the most useful direction.

Station Approaches.—A low general illumination is required along the approach to a station to facilitate the ready access and exit from the station by pedestrians and vehicles. A low-candle-power unit inclosed in a diffusing sphere is preferable for this class of lighting, rather than a high-candle-power unit, with its tendency to dazzle the approaching patrons. Ornamental iron or concrete standards will add to the attractiveness of the system in most installations.

Waiting-Room.—A general illumination of sufficient intensity to permit of convenience in reading is required in the waiting-room. The choice of sizes and type of unit will, of course, depend on the interior construction and size of the room, large units being favorable for high intensities, high ceilings and large rooms, and small units favoring the reverse conditions. The incandescent lamp is most generally used because it lends itself well to artistic layouts. The question of chandeliers versus individual units must be solved by compromising between light distribution and architectural appearance.

In general it may be said that the fewer the number of light centers the more pleasing the artistic effect. On the other hand, as pointed out above, too few light centers may produce objectionable lack of uniformity as well as appreciable shadows. The properly designed installation will strike a balance between these considerations.

The larger the number of smaller units, the report continued, the nearer we approach to uniform illumination and absence of shadows, but as we go to the smaller units the

maintenance cost increases, so we must further compromise between uniformity of illumination and cost of maintenance.

Baggage-Room.—A medium general illumination, augmented by local lighting over the attendant's desk and receiving window, will generally suffice for this class of lighting. High-efficiency incandescent lamps equipped with suitable reflectors suspended close to the ceiling are well adapted for the general lighting, while low-candle-power carbon lamps and opaque reflectors will provide the required local lighting. Where storage bins, used for checking parcels, are required to be lighted a low-candle-power carbon lamp, equipped with a reflector to concentrate the rays on the bins and suspended on a drop cord, will in most cases meet the requirements.

Offices.—Because of the exacting nature of office work, a strong general illumination with as large units as is consistent with good distribution is productive of good results. The lamps should be suspended near the ceiling and provided with reflectors to avoid glare and secure even distribution of light. This system of providing a good general illumination makes the lighting independent of furniture arrangement and discourages the use of the local light with its unsightly appearance, glare and cost of maintenance. Local lighting is also to be discouraged because it invites rearrangement, such as changes in mounting, height and type of reflector or lamp, by the desk users, who are rarely qualified to make such rearrangement. A slightly lower intensity will suffice in a private office where little clerical work is done.

General indirect lighting is also finding favor for office illumination, its strong point being absence of glare and annoying shadows.

Yards.—It is needless to emphasize the necessity of providing a good reliable system of illumination in the classification yards. Here cost of installation and maintenance should be subordinate to reliability of service and proper intensity and distribution. The character of the work requires that the space between the cars, tracks and switches be properly lighted regardless of how dark the night or bad the weather. Safety to workmen and the economical handling of the cars are essential to keep in mind.

The properties of a lamp chosen for this class of work should be good distribution, reliable action and a color of light suitable for penetrating smoke, fog, etc. The flame lamp, with its penetrating yellow flame and high efficiency, lends itself admirably to this class of work. The development of the long-life electrodes has added an impetus to the adoption of this type of lamp. Large-type tungsten-filament lamps are now developed that, used under suitable reflectors, are also useful for this class of work. The unit should be suspended high in order to avoid decreasing the ability of the eye to see and to eliminate shadows between cars. Units should be spaced to provide an even illumination of sufficient intensity to make the lettering on the car legible at the required distance. The lighting requirements in the terminal yard are possibly slightly less severe, but can be handled in about the same manner.

Shops.—The lighting of shops is a very broad question, involving as it does many classes of work and types of buildings. Each shop is a problem in itself which can be successfully solved only by a study of local conditions and requirements which determine the type of lamp, its height and equipment. The usual practice is to provide a good general illumination and augment this with local lighting at the tool when necessary.

An essential feature of a well-lighted shop, when only general lighting is employed, is uniformity of intensity, a low but sufficiently uniform intensity being preferable to a high intensity characterized by brightly lighted spots which make the less brightly lighted spots appear dark by contrast. Uniformity is favored by a large number of small units, while low maintenance, low initial cost of lamps, wiring, etc., are obtained by a fewer number of larger units. The type of unit, then, and its spacing must be chosen after due consideration of the conditions, preference being given to as large a unit as possible consistent with a reasonably even distribution of light.

APPROXIMATE EFFICIENCY FACTORS WITH NEW LAMPS AND CLEAN GLASSWARE.

Equipment.	Color of Walls.	Color of Ceiling.	Dimensions (ft.)	Ceiling Height (ft.)	Per Cent Efficiency.
Prismatic or opal reflectors at ceiling	Light	Light	40x40 or more	10 to 16	55 to 65
Prismatic or opal reflectors at ceiling	Dark	Light	40x40 or more	10 to 16	50 to 60
Prismatic or opal reflectors at ceiling center	Light	Light	15x15	8.5 to 10	50 to 60
Prismatic or opal reflectors at ceiling center	Dark	Light	15x15	8.5 to 10	45 to 55
Prismatic or opal reflectors at ceiling center	Dark	Dark	15x15	8.5 to 10	30 to 40
Bare lamps at ceiling center	Dark	Light	15x15	8.5 to 10	30 to 40
Bare lamps at ceiling center	Light	Light	15x15	8.5 to 10	40 to 50
Bare lamps at ceiling center	Dark	Dark	15x15	8.5 to 10	20 to 30
Indirect cove	Light	Light	30x50	15 to 18	15 to 25
Indirect efficient conical reflectors on central fixtures	Light	Light	40x40 or more	10 to 15	34 to 44
Indirect efficient conical reflectors on central fixtures	Light	Light	15x15	8.5 to 10	32 to 42
Indirect efficient conical reflectors on central fixtures	Dark	Light	15x15	8.5 to 10	22 to 32

Care should be exercised in the placing of the lighting to avoid excessive glare. This is effected in the choice of unit, type of reflector and height of suspension. Obviously the best solution is to use low-candle-power lamps for bays with low ceilings and *vice versa.* Local lighting at machine tools is best obtained by a low-candle-power lamp equipped with a metallic reflector to concentrate the light on the work and to shade the eyes of the workman from the bare filament. This reflector should be mounted in such a way that the light rays do not strike the workman's eyes.

Dining-Room.—Here the artistic considerations predominate, efficiency being a secondary consideration. A good general illumination of a pleasing color should be provided, floor outlets being installed to afford ready connections for candelabra and other table decorative schemes.

Lunch-Rooms, Counters, Etc.—A less artistic scheme of lighting answers in lunch-rooms. Good general illumination, favoring the counters slightly, will in most cases meet the requirements.

The following tables give some idea of the present-day practice in illumination intensities recommended for the various departments of a railroad station:

AVERAGE INTENSITIES OF ILLUMINATION—RAILROAD STATION LIGHTING.

	Ft. Candles.
Station approach	0.25 to 1.00
Waiting-room	2.00 to 3.00
Baggage-room	0.50 to 1.50
Offices (general)	3.00 to 5.00
Offices (private)	1.00 to 3.00
Dining-rooms	2.00 to 3.00
Lunch-rooms and counters	1.00 to 3.00

Train Sheds and Platforms.—A general illumination is required of sufficient intensity to afford convenience to

passengers in passing to and from the trains and to enable conductors and trainmen to inspect the tickets, and also to facilitate the handling of baggage.

Because of the prevailing high ceilings of train sheds, the lighting has been confined principally to the larger units such as arc lamps. However, since the development of the high-efficiency incandescent lamp in large sizes we may expect a goodly share of this class of lighting to go to the incandescent lamps. In low-ceiling sheds relatively small units located between tracks give better results from the standpoint of light distribution and consequent avoidance of shadows.

Freight House and Platform.—The requirement for this class of lighting is low general illumination, sufficient to discharge or load and sort the various classes of freight. This may be accomplished best by incandescent lamps, the type of lamp being governed by the height of roof truss. In most cases the high-efficiency incandescent tungsten-filament lamp will be found best adapted, and this should be equipped with suitable reflectors and suspended close to the ceiling. For buildings with high ceilings where the lamps may be hung at a height sufficient to eliminate objectionable glare and also secure proper distribution the flame or luminous-arc lamp may be used to good advantage. Where there are receiving and shipping desks or tables these can be lighted by means of drop lights, consisting of small-candle-power lamps equipped with metal reflectors. These reflectors should be of such shape as to screen the lamp filament from the clerk's eyes.

The lighting of platforms is accomplished to best advantage by means of small-candle-power incandescent lamps. These units should be equipped with metal reflectors and suspended either from wall bracket arms on the side of the shed or else from the roof where the platforms are covered by projecting eaves. The intensity of illumination required for this class of work is about the same as that necessary for the interior lighting of freight houses.

LETTERS TO THE EDITOR.

Soldered Wire Connections.

To the Editor of Electrical World:

SIR:—Your first issue of November contains an article on page 1144 entitled "Method of Soldering Wires in Terminal Lugs," to certain portions of which the writer wishes to take exception. While the method described may prove satisfactory in appearance to all and in stability to some, there will yet remain a few who will agree that in few cases will the method described produce a first-class job.

To secure proper adhesion between wire, solder and lug the temperature of all three must be above the melting point of solder at the instant of contact. If this condition does not exist nothing more than a good friction fit of all three parts will be secured; and if any doubt as to the truth of this exists in the mind of the reader let him apply a steady torsional strain to the wire or lug so secured.

While the use of a soldering pot as described is desirable, unless a method of heating both lug and wire be employed in conjunction, stability is sacrificed to speed and appearance. This is particularly true when the wire to which the terminal is to be soldered happens to be a "stranded conductor," wherein, to secure maximum mechanical strength and electrical conductivity, it is absolutely essential that the solder be maintained at the melting point until it has thoroughly permeated the interstices of the conductor.

It might be suggested that were the wire terminal and lug to be held in the molten solder until they had acquired a temperature equal to that of the solder, the method described would be ideal. To prevent adhesion of solder to the outside of the lug it should first be dipped in a light oil of high flash point, being careful to see that no oil is permitted to reach the inside of the lug. It will be found advisable when holding the bared ends of heavy conductors in the solder pot to wrap the insulation well with a rag previously wrung out in cold water to prevent as far as possible the melting of the insulating compound and the consequent smearing of the terminal. However, any such drip will not impair the joint if properly made, though it will detract from the appearance of the finished job.

Pawtucket, R. I. FREDERICK P. KENNY.

Registering Maximum Demand.

To the Editor of Electrical World:

SIR:—The editorial in your issue of Nov. 4 entitled "Maximum Demand and Size of Residences" has undoubtedly been widely read with much interest. The oftener the question of maximum demand is discussed, the more surprising it is that no better means has been found for determining this important factor. It is true that floor area gives an approximate measure for the demand, on the same principle that a man's chest measure gives some indication of the size of his collar or shoe, but it can scarcely be said to be customary to order these articles of wearing apparel in this manner.

If such a method is to meet with general acceptance by central stations, it is only reasonable to suppose that the public will have little faith in measuring instruments used by them. No eulogy on the watt-hour meter is necessary. It is a beautiful piece of mechanism, but to yoke it with a floor-area maximum-demand indicator seriously affects, if not entirely destroys, its accuracy, since both factors, maximum demand and consumption, are necessary to obtain a net result. Just what constitutes an "active room" is likely to become as much of a riddle as "What is whiskey?"

If the maximum demand is desirable in order to know the equipment necessary to serve a customer, why should heating appliances be exempt? Certainly all kilowatts of demand look alike so far as investment is concerned; and to adopt such a system as noted in the editorial only makes an arbitrary rate more arbitrary. In some companies a flatiron represents peak load and theoretically should be penalized instead of being favored.

Incidentally, in passing, I would take issue with the statement, "It is interesting to note the progress of a residence rate which a few years ago was comparatively little known, but through its merits secured the indorsement of the National Electric Light Association rate committee above referred to." On page 31 of the committee's paper there is this statement in italics: "The committee is by no means unanimous as to whether a differential for residential business is desirable." Furthermore, there is a grave doubt as to whether "progress" is correctly used as above quoted. If such a maximum demand "meter" as floor area represents progress, then we should retrogress and adopt a meter which really measures and for which eveyone including the general public can have respect.

There is a system for determining maximum demand for power installations, the details of which are mentioned in the National Electric Light Association *Bulletin* for July, paragraphs 22-54, which is almost as logical as the residential system referred to, namely, to take a percentage of the connected load, apparently without respect to the nature of the load. One of the strongest points in favor of electric service is that it is popular in spite of the charging methods in use.

The writer some months ago devised a maximum-demand indicator to place on any watt-hour meter, direct or alternating current, single-phase or polyphase, but when a

search was made of the Washington records Patent No. 722,030 was disclosed, which was granted March 3, 1903, on an application filed by C. H. Merz, of Westminster, England, Sept. 25, 1902.

In the writer's design, which conflicts with the above, it was intended that the device be mounted complete on the registering mechanism. The clock runs for only ten or twenty minutes and hence need not be an elaborate affair. It is rewound by a line-actuated solenoid. This indicator was the result of appreciating thoroughly the necessity for a maximum-demand meter for small installations the price of which would not be prohibitive. This indicator could be manufactured and attached to any meter-dial train at a cost not exceeding $3. I am not seeking litigation and have dropped the matter so far as a patent is concerned, but do not intend abandoning the subject until someone explains why it is that a patent can be issued in this country and smothered for eight years, while during this time central stations either pay a sum running into three figures for kilowatt maximum-demand meters or else adopt methods for measuring energy which no reputable concern should countenance for a moment and which every customer should rightly condemn. It is farcical in the extreme to see instruments of precision relegated to the background or else coupled with an arbitrary standard (!) due to our archaic patent laws, business regulations or what not.

The American owner of Patent No. 722,030 states that these maximum-demand attachments can be expected to be on the market in the next few months, but where have they been for the past eight years?

Pawtucket, R. I. Cecil W. Brown.

[The patent describes a watt-hour meter attachment actuated or controlled by a clock mechanism, by means of which at definite intervals of time a disk frictionally driven by the meter is brought back to an initial position. A pin on this disk acts on an indicating arm, initially moving the arm through an angular distance proportional to the energy passing through the meter in a fixed period of time; the arm then remains in this position until when the consumption through the meter is greater during the fixed period of time, when it is advanced further by an amount corresponding to the difference. Thus the position at any time of the arm indicates the maximum demand which up to that time has occured, not momentarily, but in a significant period of time.—Ed.]

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Direct-Current Turbo-Generators.—R. J. Roberts.—An illustrated paper read before the Manchester Section of the (British) Institution of Electrical Engineers. The author discusses some of the mechanical difficulties experienced with direct-current turbo-generators and suggests methods for removing them. He considers that the mediocre performance of these machines in the past has been due to inadequate comprehension of the mechanical problems. After a brief discussion of the construction of the stator the author deals with methods of ventilation. The quantity of air generally used for cooling purposes is from 80 cu. ft. to 100 cu. ft. per minute per kilowatt loss, and where the commutator is separately cooled the commutator losses are excluded. The power required for fans and air friction is generally a large proportion of the total loss. The power required by the fan varies from 4 kw to 18 kw as the total output increases from 100 kw to 750 kw. An improvement in fan loss might possibly be secured by doing away with radial ventilating ducts in the rotor and merely using axial ducts, as shown in Fig. 1. The adoption of this or a similar scheme would mean a reduction in fan loss of from 1 to 1½ per cent. Further, a still greater reduction might be obtained by discarding inefficient fans on the rotor and using a more efficient separately driven fan. The author then discusses the construction of the shaft, the rotor, the banding or end-turn sheaths, the commutator and the brush gearing. As to probable improvements of construction he thinks that one of the ultimate aims is the decrease in span between bearings. This may lead to reversion to the Eickemeyer or butterfly winding for armature, with the equalizers possibly combined in the end connections. The radial type of commutator is possibly the ultimate general design, but it will be some years before this type is generally adopted, and in the meantime great improvements may be effected by the use of higher brush pressures and higher current densities and peripheral speeds. A suggestion for the mounting of the commutator is shown in Fig. 2. The brush holders are yet very far from perfect, and possibly the present almost universal box-type holder will disappear for some form of the old lever-type holder.—Lond. *Electrician*, Nov. 10.

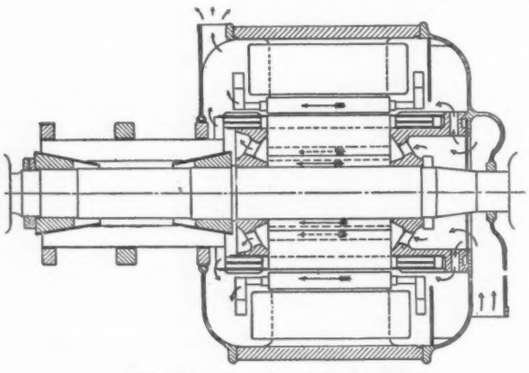


Fig. 1—Direct Turbo-Generator.

Synchronous Machines for Voltage or Current Regulation.—R. Moser.—The author proposes to discuss the use of synchronous machines for producing a constant voltage or for producing a constant current or for compensating the voltage drop in long lines. The author first takes up the separately excited machine and follows this by a discussion of the synchronous commutator machine and of the constant-voltage machine. The article is to be continued. A complete abstract will be given when the article is finished.—*Elek. Zeit.*, Nov. 9.

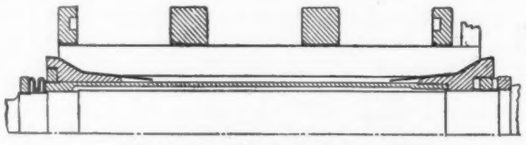


Fig. 2—Mounting of Commutator.

Carbon Brush Connections.—A note on a recent British patent (No. 76, Nov. 2, 1911) of the British Thomson-Houston Company (General Electric Company of this country). In a method of connecting flexible conductors to brushes, a hole is drilled in the brush, into which a loop of the conductor is placed and secured by a cement, which in hardening expands and makes good contact with the brush. Any cement which expands on hardening can be

used. A cement known as "smoothon" and consisting of 70 per cent of cast-iron fillings, 25 per cent of plaster of paris and 5 per cent of free carbon gives good results.—Lond. *Elec. Eng'ing*, Nov. 9.

Lamps and Lighting.

Neon Tube.—G. CLAUDE.—The author has shown that the absorption of the luminescent gas which occurs in neon tubes is due to the volatilization or disintegration of the electrodes, and that by reducing the volatilization by using electrodes of very large surface the absorption may be rendered negligible and tubes of long life may be obtained. Further, the gases obtained by treating the particles of volatilized metal with nitric acid contain besides neon quite a proportion of helium. According to the investigations of Ramsay and the author, this curious phenomenon must be due to a selective action of the volatilizing metal on the helium which is contained in the neon, but in too small a quantity to be detected by the spectroscope. It seems an established fact that the transfer of the electric charges in the tube is brought about by the intermediary of the helium which is present.—*Comptes Rendus*, Oct. 16; *La Lumière Elec.*, Nov. 11.

Metallic-Filament Lamps.—R. A. HOUSTOUN.—A continuation of his long serial on studies in light production. The present instalment deals with metallic-filament lamps and gives data on the temperature and radiant efficiency. Mention is made of an investigation by G. Leimbach, from which the following table is taken. The first column gives the name of the lamp, the second its watts per hefner candle, the third the ratio of total energy radiated to total energy supplied in per cent, the fourth the "radiant efficiency," and the fifth the "luminous efficiency."

	Watts per Candle.	Percentage Radiated.	Percentage Radiant Efficiency.	Percentage Luminous Efficiency.
Carbon glow lamp	3.8	61.9	2.85	1.75
Nernst	2.0	49.2	4.43	2.17
Tantalum	2.0	64.8	4.26	2.75
Osram	1.5	75.6	4.63	3.50
A. E. G. metal filament	1.7	80.5	4.41	3.55
Bergmann	1.7	68.5	5.03	3.44
Just Wolfram	1.7	72.2	4.44	3.20
Sirius colloid lamp	1.5	65.4	5.42	3.55

The total energy radiated was ascertained by taking readings with a bolometer in different directions. The light was separated from the dark heat by means of a ferrous ammonium sulphate filter. The third column is especially valuable. It constitutes the only reliable data available on the convection and conduction loss of incandescent lamps.—Lond. *Electrician*, Nov. 10.

Theater Lighting.—An illustrated description of the electric equipment of the new London opera house of Oscar Hammerstein. The supply of energy is obtained from two companies both on the direct-current system, the pressure being 200 volts for motor service and 100 for lighting. Twelve circuits control the stage arc lamps, thirty-two the stage lighting through dimmers, twenty the auditorium through dimmers, and fourteen the stage generally. The stage is lighted from above by means of eight battens each containing 200 lamps, while at the stage border are another 250 lamps. There are seventy-five lamps at each side of the proscenium opening, and there are also twelve hanging lengths of twenty-four lamps at the sides of the stage. Metallic-filament lamps have been used throughout and are in four different colors. In addition to this there are eight large projector lanterns to give several effects, such as sunrise, sunset, rainbow, storm, waterfall, etc. There are six bunch lamps, each containing twenty-four lamps and thirteen stage plugs. The candle-power of the metallic-filament lamps varies from 16 cp to 250 cp, 32 cp being the most general size. The stage lighting requires about 2300 lamps and the house 3000. This represents a load of about 200 kw, exclusive of the arc lamps and stage gear.—Lond. *Electrician*, Nov. 10.

Generation, Transmission and Distribution.

Induction Motors for Driving Winding Engines.—H. J. S. HEATHER.—An article illustrated by diagrams in which the author discusses the safety of induction motors for driving winding engines, and shows that the automatic cutting off of the supply can rarely do any good and may do considerable harm. The author thinks that on induction motors for winding engines no-voltage releases, if used at all, should be set very low; that overload releases, if used, should be regarded only as a means of preventing further damage to a broken-down machine, and should therefore be set at a current higher than any that the motor can possibly take under any conditions of speed and rotor resistance so long as the insulation holds; and that a runaway governor, if used, should apply only the mechanical brakes and should certainly not cut off the electrical supply.—Lond. *Electrician*, Nov. 10.

Generation, Transmission and Distribution.

Electricity in Mining.—An illustrated article describing the electrical equipment of the Rhymney Valley collieries of the Powell Duffryn Steam Coal Company, which include generating plant driven by coke-oven gas and exhaust steam, as well as two of the largest electric winding plants in the world at a colliery which is entirely without boilers. From an electrical viewpoint the Britannia colliery is the most interesting of this group. For winding the Ilgner system is employed. The flywheel is attached to a motor-generator consisting of an induction motor of the slip-ring type driving a pair of continuous-current generators, which supply current to the two large slow-speed motors directly coupled to the winding drum. The speed and direction of motion by the winding motors is controlled, as in the Ward Leonard system, entirely by varying the field magnetism of the generators, the armature circuits never being broken. Each winding drum is coupled to two motors, one at each end, and each is rated at a maximum of 2160 hp and a normal output of 1300 hp. They run at a maximum speed of 62.8 r.p.m., and the emf at the armature terminals varies from 0 volt to 600 volts. They are separately excited from a 200-volt circuit receiving energy from separate motor-generators. They are sixteen-pole machines with interpoles as well as distributed compensatory windings to perfect the commutation. The two flywheel sets, one for each winding plant, consist each of an induction motor, two direct-current generators and a 33-ton solid-steel flywheel running at a maximum speed of 500 r.p.m. and capable of storing 30,000 ft.-tons. The two sets are placed in line and can be coupled together, so that when the two plants are winding coal each will assist in dealing with the peaks of the other. Further couplings are provided between each motor-generator and its flywheel, so that the set can be run in any one of the following ways: Either motor-generator alone with one or both flywheels or without a flywheel, both motor-generators entirely without flywheels, or the whole coupled up together.—Lond. *Elec. Eng'ing*, Nov. 2.

British Energy Supply Statistics.—Statistical tables giving information on 119 British energy supply stations in fifteen different columns, concerning equipment, rates and uses of energy.—Supplement to Lond. *Electrician*, Nov. 3.

Chicago Generating Plant.—An illustrated description of the new generating station of the Commonwealth Edison Company in Chicago.—Lond. *Elec. Review*, Nov. 10.

Installations, Systems and Appliances.

Time-Limit Cut-Out.—D. H. OGLEY.—The author has made experiments with a cut-out fitted with a time-limit device in which a small piston, attached to the plunger of the cut-out, moves in a cylinder containing about ⅛ in. of pure glycerine. The plunger is prevented from rising immediately the current reaches the value indicated on the particular setting, by reason of the viscosity of the glyce-

rine. The time taken to release the piston, therefore, depends upon the thickness of the glycerine and hence upon the temperature. The author tested the device at different temperatures and his results are given in several diagrams. The chief conclusion which may be drawn from them is that it is useless to attempt to calibrate a cut-out fitted with such a time-limit device, except at the temperaure at which it will have to operate.—Lond. *Elec. Review,* Nov. 10.

Charging for Electrical Energy.—Glässner.—Several fair rates have recently been proposed, but their introduction would involve considerable expense for such stations as use now a straight meter rate with simple meters. The author proposes a rate in which the same meters are to be used as heretofore but in connection with limiting devices which limit the load. This can be done without great expense and may offer some advantages.—*Elek. Zeit.,* Nov. 9.

Electric Heating.—An illustrated description of various arangements in which 16-cp or 32-cp carbon lamps are used for heating and cooking purposes.—*Elek. Zeit.,* Nov. 9.

Electrophysics and Magnetism.

Afterglow of Electric Discharge.—R. J. Strutt.—A paper read before the (British) Physical Society on further observations on the afterglow of the electric discharge and kindred phenomena. It is shown that ozone prepared by means of the Siemens ozone tube used at atmospheric pressure is able, when mixed with nitric oxide, to give the greenish-yellow afterglow flame. This result is attained only when the ozone has been concentrated by fractional distillation. A blue glow is obtained under the same conditions with sulphuretted hydrogen and ozone. The effect of sulphur compounds in improving the air glow noticed by the older experimenters is shown to be due not to any direct intervention of these bodies in the reaction, but to their power of destroying organic matter prejudicial to ozone. When once this is got rid of the sulphur compounds are of no further advantage. It is found that pure oxygen does not give an afterglow. The afterglow seen in electrodeless bulbs containing oxygen is due to some interaction with water vapor. The luminosity given out when ordinary spring water is shaken with ozone is shown to be due to oxidation of peaty matter contained in it. Brown peat water gives greatly enhanced luminosity—Lond. *Electrician,* Nov. 10.

Homogeneous Fluorescent Röntgen Radiation.—C. G. Barkla and Nicol.—An abstract of a paper read before the (British) Physical Society. It was formerly shown by one of the authors that the fluorescent Röntgen radiations emitted by elements exposed to primary Röntgen radiation can be arranged in series, one radiation in a particular series being emitted by each element and the radiation belonging to that series becoming more penetrating with an increase in the atomic weight of the radiating element. The homogeneity of radiations of only one series (the K series) was shown by Barkla and Sadler. The present paper describes experiments showing the homogeneity of fluorescent Röntgen radiation in the second series (the L series) and exhibiting the homogeneity of radiations of the two series from a number of elements. Details are given of the observations on the radiations from barium. Similar results are recorded in the case of the radiations from iodine, antimony and silver. The homogeneous fluorescent radiations of different series are emitted simultaneously by an element exposed to Röntgen radiation of a more penetrating type than either.—Lond. *Electrician,* Nov. 10.

Electrochemistry and Batteries.

Energy Consumption in Electric Steel-Refining Furnaces.—Carl Hering.—In electric steel-refining furnaces the metal is to be kept at a constant temperature during the process of refining. On the basis of certain assumptions which are given in detail the author calculates what would be the maximum economy of energy which could be obtained in such a furnace. A furnace of hemispherical shape is assumed to get as small a surface as possible. The basis of the calculation is a figure for the constant loss per square foot of metal surface taken from tests of the Hiorth induction furnace, namely, 1.2 kw per square foot. This figure also agrees well with results obtained with another

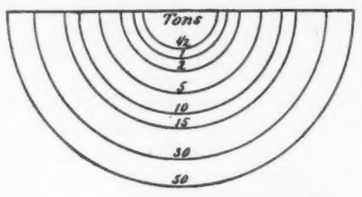


Fig. 3—Increase of Size of Furnace with Increase of Capacity.

furnace. On this basis the author calculates the following table. It gives the kilowatts which will be required on the above basis to keep steel at the refining temperature, the bottom of the hearth being hemispherical and the metal just filling the hemispherical part. Hence it gives the least number of kilowatts, or kilowatts per ton, of charge required under the best practical conditions for obtaining the least loss. Fig. 3 shows the increase of size of furnace with increase of charge rating, and Fig. 4 the minimum kilowatts per ton as a function of size of furnace (condition of least loss).

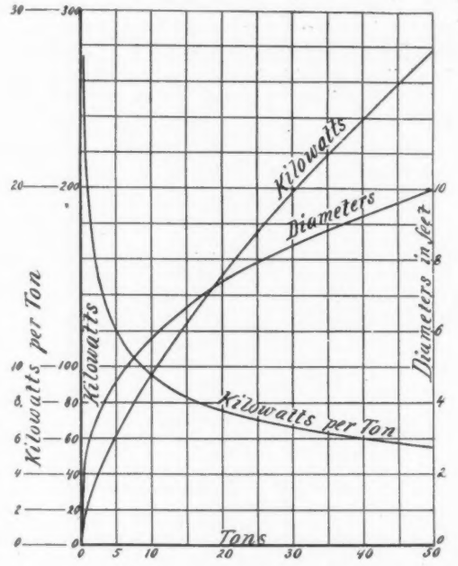


Fig. 4—Minimum Kilowatts per Ton as Function of Size of Furnace (Condition at Least Loss).

Capacity.		Diameter in Feet.	Kilowatts.	Kilowatts per Ton.
Gross Tons per Charge.	Cubic Feet.			
½	2.57	2.14	13	26.0
1	5.13	2.70	20	20.0
2	10.3	3.40	32	16.0
5	25.7	4.61	60	12.0
10	51.3	5.80	95	9.5
15	77.0	6.65	124	8.0
30	154	8.38	200	6.6
50	257	9.93	278	5.5

The author believes that even these low figures can be improved upon.—*Met. and Chem. Eng'ing,* November.

Electrometallurgy.—A note on three electric-furnace papers recently presented before the Faraday Society. J. Harden described the Paragon combined arc and resistance

furnace. D. F. Campbell discussed progress in the electrometallurgy of iron and steel. E. K. Scott described the Hering pinch-effect furnace.—Lond. *Elec. Eng'ing*, Nov. 9.

Units, Measurements and Instruments.

Systems of Units.—K. SCHREBER.—The author first formulates sharply the definitions of weight, force, mass and material and emphasizes that weight is a special form of force and that mass and material are two very different conceptions. He discusses the question whether the unit of mass or the weight of force should be used, besides the units of space and time, as the foundation of a rational system of units. As to suitability and ease of use either would be good enough, but since the mass appears only in a part of the mechanics, while the force is used not only in the whole of mechanics, but in almost all other fields of physics and engineering, he concludes that the only justified system of units should be based on the unit of force.—*Elek. Zeit.*, Nov. 9.

Emf of Weston Cell.—P. JANET, F. LAPORTE AND R. JOUAUST.—As the result of various corrections the value of the emf at 20 deg. C. of the standard Weston cell, on the basis of the definitions of the true ampere and the international ohm, is 1.01836 volts, instead of 1.01869 volts, which was the former value.—*Comptes Rendus*, Oct. 16; *La Lumière Elec.*, Nov. 11.

Testing Iron Sheets.—VAN LONKHUYZEN.—The author modifies a measuring method of Maxwell in such a way that it may be used for the commercial testing of sheet iron according to the standardization rules of the German Association of Electrical Engineers. It is a ballistic differential method, which when compared with other ballistic methods has several advantages because the ballistic galvanometer is replaced by a needle galvanometer (used as zero instrument) and because the accuracy of the method is high on account of the compensation of the sources of error and the method is very convenient to execute. Two sets of apparatus for using the method are described.—*Elek. Zeit.*, Nov. 9.

Hot-Wire Ammeter.—R. HARTMANN-KEMPF.—An illustrated description of a hot-wire ammeter without shunt for wireless telegraphy.—*Elek. Zeit.*, Nov. 9.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—The first part of a detailed and profusely illustrated description of the singing quenched-spark system of the Telefunken company. When two oscillating circuits are coupled together the energy sways backward and forward from one to the other, and each circuit emits waves of two frequencies, and this leads to serious inefficiency in practice with the usual spark, because only one of the two frequencies can be utilized. M. Wien has shown that if the oscillations in the primary circuit are stopped as soon as the secondary circuit is oscillating the latter will continue to oscillate at its natural period, and will therefore emit waves of only one frequency. A much higher efficiency is, therefore, to be expected with the "quenched spark" than with the ordinary spark. What takes place is shown graphically in Fig. 5. It will be seen that the spark is quenched as soon as the energy in the primary circuit is a minimum and that in the secondary a maximum. Thus, after quenching, the primary no longer oscillates, and the secondary oscillates with its natural period; so that, under suitable conditions, a feebly damped train is obtained, as indicated. The conditions for quenching are easily obtained. With ordinary circular electrodes placed close together, or even with quite thin plates placed edge to edge so as to form a small gap, quenched sparks are obtained and will continue so long as the heat is conveyed away rapidly enough. As soon, however, as the electrodes become hot the spark becomes an arc and quenching no longer occurs. Also, a single wave is not obtained unless the spark gap is quite small. A section of the spark discharger as now used by the Telefunken Company is shown in Fig. 6. It consists of circular plates of copper, each faced with a plate of silver, which is ground true except that it is slightly recessed at the center. There is a groove some distance from the center and the metal plates are separated by mica rings to a distance of

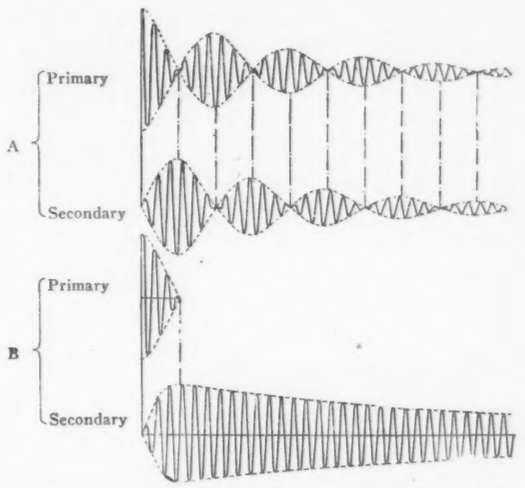


Fig. 5—Diagram of Oscillations in Coupled Circuits. A—Ordinary Spark. B—Quenched Spark.

0.2 mm. The spark forms at any point of the flat surface; it is then forced toward the periphery in a radial direction by the electromagnetic field, and is eventually extinguished on its path. A number of these spark-gaps are held in series. The pressure per gap is 1200 volts. Since the waves to be received are intermittent but rapid, so-called integrating or contact detectors are chiefly employed for receiving, the contact being between a mineral and graphite or a metal. Details are also given of the connections in the transmitting and in the receiving stations and of the

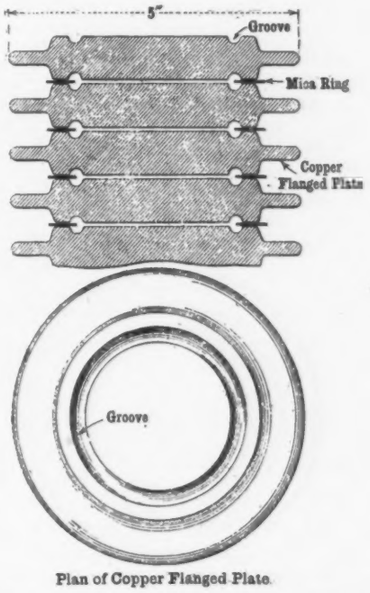


Fig. 6—Section and Plan of Spark Discharger.

arrangement of the detector and of the receiving set. The article is to be continued.—Lond. *Electrician*, Nov. 10.

Wheatstone-Bridge Connection in Telephony.—L. SABATIER.—The author has formerly discussed the connection of the microphone in shunt with the source of current instead of in series with the line and has pointed out its

advantages. He now discusses in some detail the arrangement due to Belin in which the Wheatstone bridge connections are employed. He discusses the effect of this arrangement on the efficiency of the transmission and determines the best values of the resistances of the different branches of the bridge. The results of his analysis are given in the form of diagrams.—*La Lumière Elec.*, Nov. 11.

Miscellaneous.

French Association for the Advancement of Science.—A report of the proceedings of the Dijon Congress of the French Association for the Advancement of Science. Turpain presented papers on a recording microammeter and on a thunderstorm recorder. Dauvé discussed the possibility of using the capillary electrometer in chemical analysis. Jégou dealt with several problems of wireless telegraphy, especially the prevention of interference. Blondel discussed two new methods based essentially on the use of the oscillograph for the study of acoustic phenomena. In another paper Blondel discussed the determination of the direction from which a wireless message is received by means of two receiving antennas. Broca discussed a method of measuring electrolytic resistances. Matignon dealt with recent progress in the aluminum industry. Razous discussed means for preventing the spontaneous combustion of stored coal.—*La Revue Elec.*, Oct. 27.

Mascart.—The Mascart monument at the Laboratoire central et l'École supérieure d'Électricité was recently dedicated in the presence of members of the Mascart family and representatives of the French government. The International Society of Electricians in Paris was represented by Lippmann, and the committee of subscribers by General Sebert, who made the dedication speech. This speech is given in full.—*La Revue Elec.*, Oct. 27.

Pratt Institute.—L. Fabre.—An illustrated article on the electrical engineering course in the Pratt Institute in Brooklyn.— *La Lumière Elec.*, Oct. 28.

British Institution of Electrical Engineers.—A summary of the new proposed constitution of the British Institution of Electrical Engineers and an account of the discussion of it at a recent meeting. The proposed changes, which have met with some opposition, are also the subject of a long editorial.—Lond. *Electrician*, Nov. 10.

Book Reviews.

Addresses to Engineering Students. Edited by Waddell & Harrington, consulting engineers. Kansas City, Mo.: Waddell & Harrington. 493 pages. Price, 75 cents.

The book entitled "Addresses to Engineering Students" is of octavo size, with neat dark-green cloth binding, containing 493 pages. The aim of the editors has been to place before students in engineering colleges in particular a treatment of questions of vital importance to the engineering profession. The work is the compilation of the papers and addresses of many of the most prominent engineers and educators in the country, and the reader, therefore, is treated to a condensed consensus of opinion on these matters which would be very difficult for him to secure in any other way.

The preface shows that the book is intended both for a reference book and a text for colleges of engineering, and the papers are so arranged for the latter use as to attract the interest of freshmen and sophomores and to supply them with food for thought and reflection as they become better educated and more mature. The table of contents gives the titles and authors of forty-four papers, including thirty-two different engineers and educators.

The first seven papers deal with subjects concerning the young engineer especially, as follows: "The Profession of Engineer;" "Advice to Freshmen;" "Two Kinds of Education for Engineers;" "The Durable Satisfactions of Life;" "Engineering Education;" "The Value of English to the Technical Man;" "The Necessity for Individual Engineering Libraries and for Continuing Study After Graduation."

The paper entitled "The Educational Value of the Technical Press, with Special Reference to Engineering News," points out facts about the technical press which students ought to know. They usually have but little time in college to read the technical journals, and advice as to how and what to read is profitable to them. "The Twentieth-Century Engineer" is a paper of historical interest, and also outlines the place and importance of engineering to-day. "Business Training for the Engineer" is a subject of vital importance to the practising engineer, and greater emphasis even than the author places upon the teaching of English, the law of contract and the business side of engineering would have enhanced the value of the paper. "Some Relations of the Engineer to Society," "Engineering and Life," "The Present Status of the Engineering Profession and How It May Be Improved," "The Engineer's Duty as a Citizen," "The Next Step," "The Engineer as a Professional Man" and "Success" are papers whose value can scarcely be overestimated in considering and emphasizing the ethics of the engineering profession.

"Study Men" is a paper which gives advice "the soundest of the sound," as stated in the editors' prefatory note concerning it, and while it is an address to engineering students, older practitioners can well afford, to their profit, to heed what is said. Papers dealing with graduate study and higher education for engineers, and the final paper in the book, giving an outline of "The Human Side of the Engineering Profession," furnish much of interest and value to the mature engineer.

The value to the engineer of the use of good English is made prominent throughout the book, not only by emphatic statements in various paragraphs concerning it, but by the general character of the book itself. The prefatory notes by the editors are valuable in giving the reader a brief outline of the work and position of the author of the paper immediately following.

Though one might hope to find within the pages a paper by some municipal engineer on a subject dealing with engineering and political science, little can be said in adverse criticism of the book as a whole as one quite fulfilling the intention of the editors. The index to the book covers twelve pages and is unusually complete, with 2085 references. The book is clearly and accurately printed on substantial paper; it is strongly bound, and the title is prominent on the back in gold letters on the dark-green covering.

Walker's Loose-Leaf Pocketbook for Engineers. By Norman R. Corke. London: John Walker & Company, Brooklyn, N. Y.: The Cooke & Cobb Company.

This engineer's pocketbook, made up on the loose-leaf principle, is stated to be the outcome of experiments with various forms of loose-leaf and other notebooks which have been put to the test of actual use for a period extending over several years. A style of book was adopted having advantages as to mechanical construction, size and adaptability, and in order to enhance the value of the pocketbook it was decided to include a certain number of printed pages containing tables, formulas, etc. The tables in the book are those most generally useful to engineers, and they have been compressed into the smallest possible space. To add to the convenience of the book a section consisting of special paper is included. This paper is divided into centimeter, half centimeter and millimeter squares, distinguished from one another by a suitable variation in the thickness of the lines, and is printed with orange-tinted ink on one side only of a special thin paper, so that curves, etc., drawn on it with India ink may be reproduced by blueprinting in the usual manner. There are also plain blank pages which may be used for making blueprint copies of any diagrams or matter of which more than one copy

may be desired. These pages of section, blank and ruled paper are provided with metallic eyelets, so that they can be readily removed from the book at any time and placed in a permanent holder. The great advantage of the loose-leaf system is that it is only necessary for the user to carry about such pages as he actually requires for the time being, the other pages being filed away in special filing cases provided by the publishers, so that they may be referred to at any time or again used in the pocketbook. The book has been prepared in five editions, English, American, Canadian, French and German. Refills of the printed matter, the specially ruled or blank pages are supplied on application of those wishing them by the English or American publishers.

New Apparatus and Appliances

ELECTRIC PROJECTOR APPARATUS FOR LANTERN SLIDES AND NON-TRANSPARENCIES.

For exhibiting before small audiences projections of post-cards, photographs and other pictures on opaque materials, a type of reflector apparatus has become quite popular in which the picture is itself highly illuminated and has its reflected image thrown enlarged on a white screen. Heretofore the results obtained with such devices have been disappointing, however, on account of the dimness or low intensity obtainable at the image, making the pic-

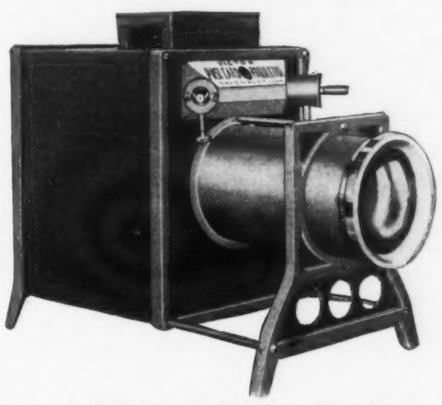


Fig. 1—Electric-Arc Post-Card Projector.

ture indistinct. This drawback has been corrected in an improved arc-lamp projector brought out by the Victor Animatograph Company, of Davenport, Ia., in which the superior brilliancy of a small electric arc is substituted for the usual incandescent unit. A small hand-fed arc is used, the slender carbon pencils being adjusted from the front of the lantern. The pictures shown may range from 2½

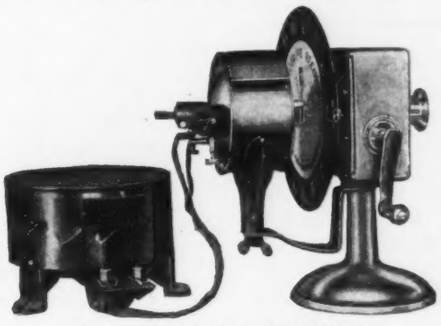


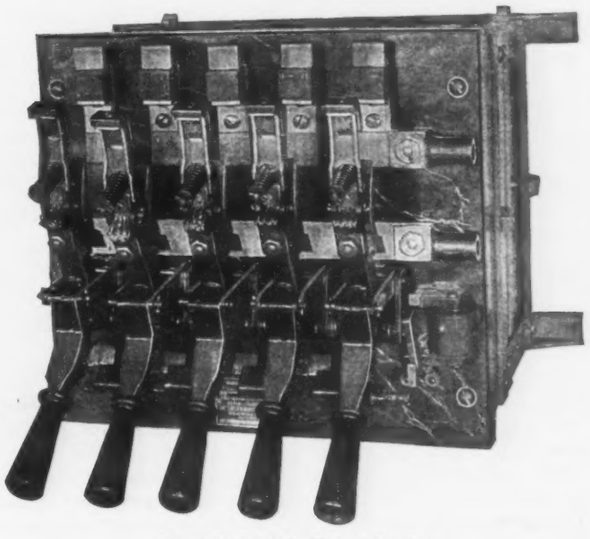
Fig. 2—Electric-Arc Stereopticon.

ft. in height at a distance of 5 ft. from the lantern to 15 ft. high at 30 ft. distance. The arc is arranged for operation with both direct and alternating current, and the rheostat connected in series with the device prevents short-circuiting when the carbons are pressed together to pick up the arc. Photographs, post-cards, newspaper clippings, etc., can be projected with this apparatus.

The same manufacturer has also developed an improved form of electric-arc stereopticon, illustrated herewith, in which the successive transparent slides, themselves measuring 21-32 in. by ¾ in., are brought opposite the projecting lens by rotating the disk shown. The separate pictures are thus bound together in groups of fifteen, and such a record can be changed in two seconds. The complete equipment is much smaller and lighter than the ordinary stereopticon, weighing complete with 210 slides only 12½ lb.

MULTIPLE-SWITCH STARTING RHEOSTATS.

The accompanying illustration shows a new multiple-switch starter of which a line is being placed on the market by the Cutler-Hammer Manufacturing Company, of Milwaukee, for use in cutting out the individual steps of resistance in accelerating large motors. The new switches used on these starters differ from former types in that a toggle-joint operation permits of closing by pushing the handle downward instead of up. The contact made is quick and absolute. In starting, the left-hand switch is closed first, then the second, third, etc., allowing a second or two between. Each switch, by means of metal stops near the handles, holds in place the switch before it. When the last switch is closed the no-voltage release magnet holds them all in contact and the entire resistance is short-cir-

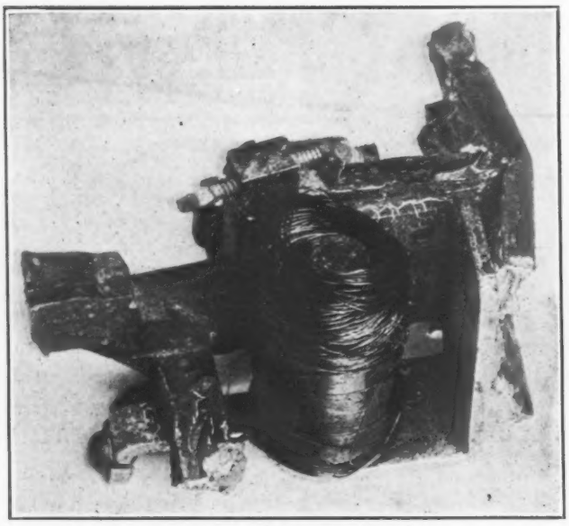


Multiple-Switch Motor Starter.

cuited. The switches cannot be closed out of order, and two or three switches, for instance, cannot be closed and the others left open. Releasing the hand from any handle except the last causes all switches to open. The motor cannot run with resistance in the circuit, and the resistance is, therefore, also protected from overheating. Overload release is included in the various types made.

BEHAVIOR OF ENAMELED WIRE UNDER SEVERE FIRE TEST.

The accompanying illustration shows a relay coil of black enameled wire which successfully withstood a fire hot enough to melt its brass frame. While the outer covering of the coil and its fiber heads were completely destroyed



Enameled Wire Coil After Fire.

and the insulating paper between the wire and core was carbonized, a test of the coil's resistance showed this to be exactly the same, 46 ohms, after as before the fire. The insulation resistance of the coil measured to its core (the separating paper being wholly carbonized) measured 10,000 megohms. The breakdown voltage of the outer layer of wire, which came directly into contact with the flames, proved to be 170 volts, an average of 94 volts per 0.0001 in. of enamel thickness, and thus exceeding the original specification of 75 volts per 0.0001 in. While the outer two layers lost somewhat in adherence and elasticity, their insulation resistance remains unchanged, and the effect of the fire is not detectable on the inner layers.

The coil shown was used in a piece of automatic telephone apparatus which was subjected to a bad fire. The manufacturer, the Automatic Electric Company, Chicago, has been a large user of this improved enameled wire in its own business for more than five years, and through its supply sales department now offers this wire under the name of "Raven enameled wire" on the open market.

BRISTOL'S FRICTIONLESS INK-TYPE RECORDING INSTRUMENT.

To meet the demand for a frictionless ink-type recording instrument to parallel the Bristol smoked-chart recorder as nearly as possible in fundamental simplicity, and to record accurately fractions of millivolts and be adapted for use as a recording electric pyrometer, the instrument illustrated herewith has been developed and placed upon the market by the Bristol Company, of Waterbury, Conn. These instruments have been tested out in practical service for two years past, and are the result of several years of study and experience with a design of a frictionless ink recorder patented in 1909, which uses a hinged electrical movement carrying a retaining receptacle for marking fluid extending over the path of the recording tip and provided with means for periodically making contact with the source of marking fluid and the chart.

Fig. 1 is an interior view, showing the galvanometer movement case hinged to the back of the instrument and carrying the inking pad in front of the recording arm. Fig. 2 shows the sensitive electrical movement swung to one side for convenience in removing the record and inserting a fresh chart. A capillary gold tube open at both ends is carried at the end of the recording arm at right angles to the surface of the chart. The inking pad is suspended from the case of the electrical movement and is curved to correspond with the arc covered by the motion of the end of the recording arm.

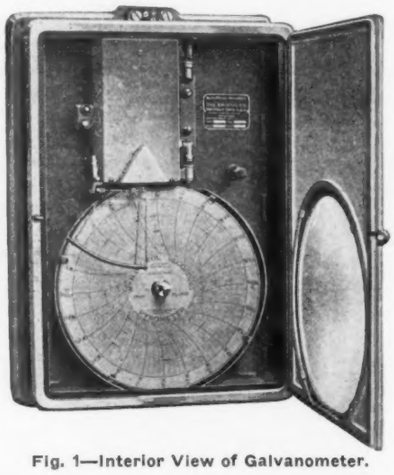


Fig. 1—Interior View of Galvanometer.

When the movement is swung back into its operating position, as shown in Fig. 1, the recording arm can swing free, accommodating itself to the position corresponding to the delicate current which is to be measured. The clock which revolves the chart at the desired speed also automatically presses the inking pad toward the chart every ten seconds, bringing one end of the capillary tube into contact with the chart and the other end simultaneously into contact with the inking pad. A fine dot of ink is left on the chart and the capillary tube is replenished with ink from the pad. The recording arm thus carries a constant supply

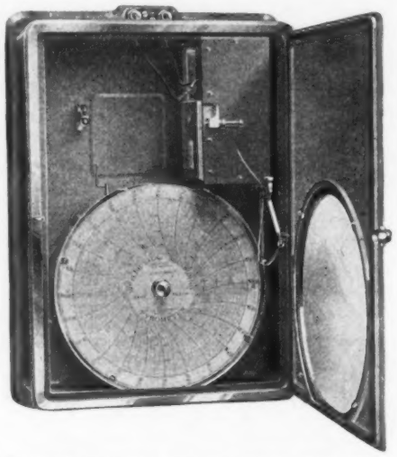


Fig. 2—Electrical Movement Swung to One Side Before Removing the Recorder.

of ink, and its perfect balance, which is very important, is always maintained. The electrical movements used in these recorders are made especially for the purpose by the Weston Electrical Instrument Company.

Although the most important applications of these recording instruments have been for pyrometers, they have also been used for electrolytic research, recording voltmeters and recording shunt ammeters.

AUTOMATIC CONTROLLERS FOR MOTOR-DRIVEN MACHINERY.

The Electric Controller & Manufacturing Company, of Cleveland, Ohio, has recently placed on the market a line of automatic controllers designed for the specific purpose of giving the utmost convenience in the control of motor-driven machinery. It has been estimated that the output of many machines can be increased 20 per cent by the central grouping and convenient arrangement of all the operating levers. "Headlines of control" is recognized as being very important in securing the utmost production from a machine, and the automatic controllers described were designed to provide this class of control for starting, stopping or reversing the motor and machine.

The controller consists of a small operator's switch and an accelerating unit. The controllers are built in three types to secure: (1) Non-reversing and dynamic braking; (2) reversing without dynamic braking; (3) reversing and dynamic braking. For each type there are four different forms of accelerating units which vary in design from a simple train of accelerating switches up to a unit having a fused service switch, a train of accelerating switches and complete circuit-breaker features, as shown in Fig. 2.

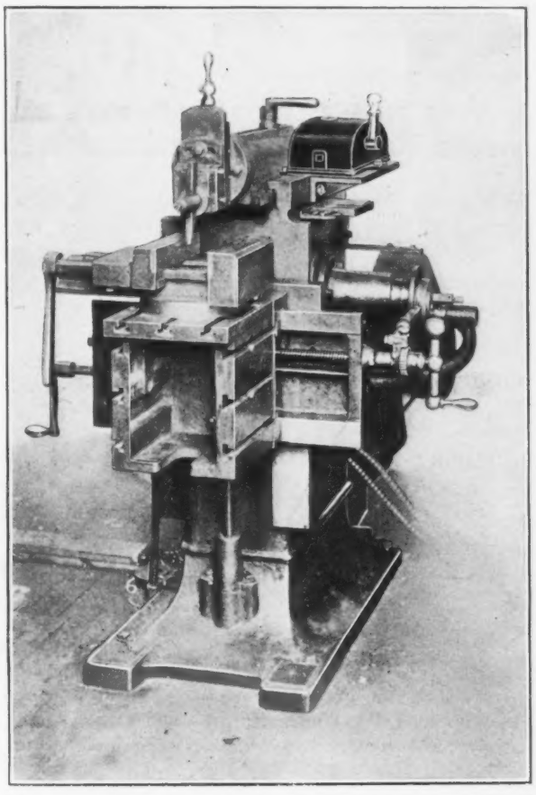


Fig. 1—Motor-Driven Shaper Equipped with an Automatic Controller.

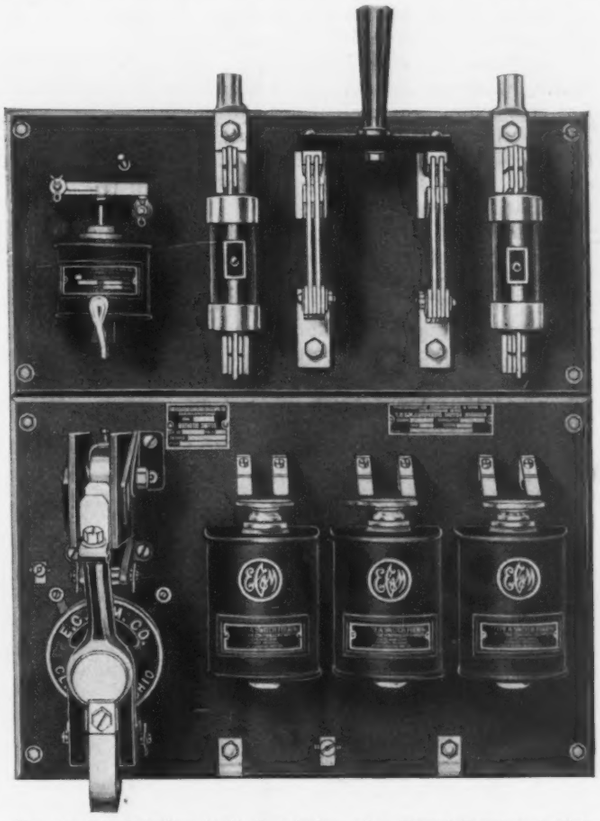


Fig. 2—Accelerating Unit Consisting of a Fused Service Switch, Accelerating Switches and Circuit-Breaker.

The accelerating unit automatically accelerates or retards the motor through the action of series-wound accelerating switches which possess the remarkable characteristic of acting not only as switches but as current-limit relays as well. When the current in the winding of one of these switches exceeds a predetermined value the switch locks open and cannot close until the current is reduced to the proper value.

When the operator's switch is thrown to the running position current flows through the motor, all of the starting resistance and the coil of the first series-wound accelerating switch. As the motor accelerates the current drops, and when it reaches the correct value the first accelerating switch closes, cutting out a portion of the starting resistance. The succeeding accelerating switches operate similarly, ultimately cutting out all of the starting resistance and putting the motor across the line. By throwing the operator's switch to its original position the motor is disconnected from the line and consequently stops. Different positions of the handle of the different types of operator's switch provide for drifting, reversing or rapid stopping by dynamic braking.

Dynamic braking is secured by a change of connections, accomplished by the operator's switch, which first inserts all the starting resistance in series with the armature. The motor is then quickly and evenly brought to rest by automatic dynamic braking, the accelerating switches in this case acting as retarding switches by cutting out step by step the resistance as the current generated by the motor decreases owing to the slowing down of the motor.

The manufacturers claim the following important advantages for this automatic controller: (1) It limits the acceleration and retardation current at all times to a safe value. (2) It accelerates and retards the motor in the minimum safe amount of time and automatically varies the time of acceleration and retardation, depending upon the load which the motor has to start and stop. (3) It provides the best conditions for good commutation. (4) By limiting the current, both in starting and stopping, it limits all mechanical strains on the motor and driven machinery. (5) It obviates the necessity of mechanical clutches on many motor-driven machine tools. (6) It adds very materially to the safety of an installation, since in case of accident the motor may be quickly stopped. (7) It inherently provides no-voltage protection, for if the voltage fails the switches drop open, and upon the return of voltage they automatically close in their regular method and sequence, again accelerating the motor to full speed.

METHODS OF CONNECTING WIRES TO TERMINAL LUGS.

By H. B. Logan.

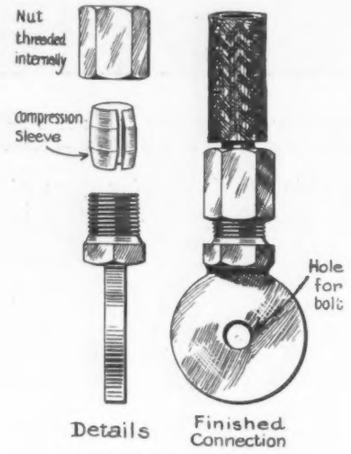
An analysis of the article by Mr. H. D. George in the issue of Nov. 4 seems to leave much to be desired in the essentials of convenience and time-saving. The article in question is in the section devoted to "Wiring and Illumination" and is entitled "Methods of Soldering Wires in Terminal Lugs." The first method described requires the following separate and distinct operations: (1) To have or procure a plumber's furnace; (2) to get it ready for use; (3) to melt a pot of solder; (4) to cut insulation from end of conductor and brighten end by scraping or sandpapering; (5) to smear the bared end of conductor with soldering flux; (6) to tin it by plunging it into solder pot; (7) to knock off surplus solder; (8) to push conductor into hole in lug; (9) to souse lug with wet waste to cool it; (10) to scrape or file off shreds and globules of solder; (11) to brighten surfaces of lug with fine sandpaper.

Contrasted with the foregoing, another method of connecting wires to terminal lugs is to use the Dossert solderless connectors, which eliminate entirely the use of solder and require only the following operations: (1) Cut insulation from end of conductor and brighten end by scraping or filing; (2) push conductor into hole in lug; (3) tighten up nut with wrench.

A comparison shows that the soldering method requires the following adjuncts: Plumber's furnace and means for heating same, solder, soldering flux, wet waste and sandpaper, whereas to connect up the Dossert lug requires nothing but a jackknife, a file and a wrench. The saving in time, labor, materials and cost is increased by the fact that soldering operations usually require a man and a helper, while a Dossert joint can be made by one man, no matter how large the cable.

As shown in Fig. 1, the shank of the Dossert lug is threaded externally while the hole is tapered. The compression sleeve is tapered at both ends and slotted longitudinally. The nut is threaded internally and is tapered at the outer end. When the conductor is thrust into the lug and the nut is tightened up the action of the tapers and slotted sleeve exerts a pressure on the cable or conductor of several thousand pounds to the square inch, according to size, thereby making good electrical contact.

At best a soldered joint is unreliable. Tin, for reasons



Dossert Solderless Connector.

unknown, very often changes its structure and becomes crystalline, and in turn affects all other metals that it comes in contact with in a similar manner. This may be the reason why cables often drop out of lugs into which they have been soldered. A Dossert lug will not heat as much as the cable which it connects when the cable is heavily overloaded.

Mr. George in his article describes another method of soldering wires in lugs, which is to heat the lug with a blow torch and when sufficiently hot feed wire solder into the hole. The solder melts and the bared conductor end is thrust into the hole, as previously described. He adds: "However, the use of a blow torch in this way should be avoided if possible, as it blackens the exposed surfaces of the lug. A thorough cleaning with fine sandpaper is then necessary and that requires considerably more time than is justifiable." This method seems to be sufficiently condemned by the statement that it should be avoided if possible, but it is also open to objections as to multiplicity of materials, operations and cost, together with the use of the dangerous blow torch with its menace as a fire hazard when brought into buildings. The high temperature to which a splice has to be heated in order to solder it injures and lessens the life of the insulation, especially if it be rubber. This bad feature is, of course, eliminated by the use of solderless connectors.

A HP-HOUR ON 21.8 LB. OF STEAM WITH HALF-LOADED NON-CONDENSING LENTZ ENGINE.

The Natrona County Electric Company, doing the electric-service business of Casper, Wyo., has had a 250-hp Lentz poppet-valve engine in service during the last eight

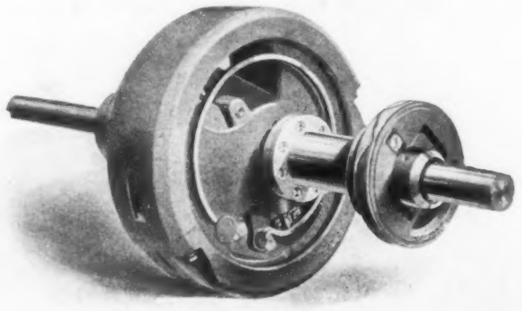


Fig. 1—Combined Inertia and Centrifugal Governor.

months, and Mr. J. A. Ward, superintendent of the company, reports some gratifying results of operation and tests of this unit. The unique features of the Lentz type of engine were described in an article on the installation at Galesburg, Ill., appearing in the *Electrical World* of May

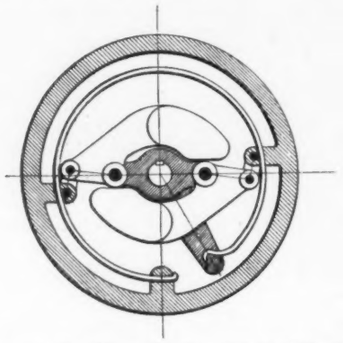


Fig. 2—Section of Combined Inertia and Centrifugal Governor.

4, 1911. Briefly summarizing these points of difference, the engine at Casper, as shown in the accompanying illustration, is of the tandem horizontal type, having its poppet-type valves operated from a full-speed lay-shaft paralleling the piston travel. The use of elastic packing is entirely

avoided in these engines, the valve-stems being ground to a 0.001-in. fit and the piston stuffing-boxes being formed by a series of accurately ground fixed and floating rings. The governor, which is of the combined inertia-centrifugal type, is shown inclosed in the globular housing opposite the high-pressure cylinder in the illustration. Its inertia

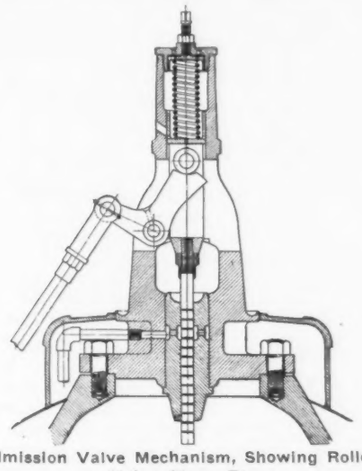


Fig. 3—Admission Valve Mechanism, Showing Roller Contact, Valve Stem, Etc.

ring and flyballs operate sliding wedges which control the throw of the eccentrics, the construction also making valve adjustments possible with the engine in motion. The lay shaft is driven by bevel friction wheels, arranged with shallow teeth projecting along one side, in order to prevent slip.

Other features of the Lentz engine are its relatively high speed, light weight, etc. The engine is a European invention, the American units described being built in this country, under license, by the Erie City Iron Works, of Erie, Pa.

The engine at Casper is of the 250-hp type, with cylinders 14 in. and 27 in. by 23 in., taking saturated steam at about 115-lb. pressure per square inch and exhausting into the atmosphere against 1½-lb. back-pressure. It drives, at 164 r.p.m., a 200-kva, 2300-volt, 60-cycle, three-phase Fort Wayne alternator. The engine was erected under local supervision, all adjustments being made as far as possible by rule. Steam was then turned on and the unit operated for six hours, after which it was shut down for only a few minutes for the purpose of making some final adjustments.

Two five-hour efficiency tests have been run on the Casper engine by Mr. Ward, showing a steam consumption of 21.8 lb. of dry, saturated steam per indicated horsepower-hour, under conditions of 115 lb. steam pressure, 1½-lb. back-pressure on atmospheric exhaust, 164 r.p.m. and 103 kw average load. These results, according to Mr. Ward, exceeded the builders' half-load guarantees by 1.3 lb., and practically equaled the full-load efficiencies promised, in spite of the fact that the half-loaded engine was operating against the back pressure, for which no allowance had been made.

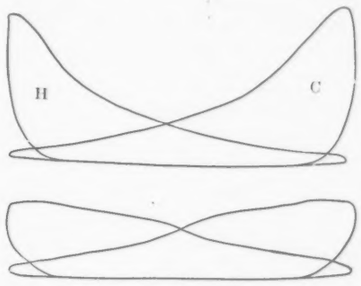


Fig. 5—Indicator Card from the Galesburg (Ill.) Engine.

In operation the packingless steam valves have been found perfectly steam-tight, and according to the plant engineer have shown themselves capable of close setting to give very perfect cards. The superintendent also calls attention to the convenience of the hand-speed adjustments, which is found especially handy when paralling alternators, as the Lentz engine is operated in connection with an Atlas belted engine.

All of the bearings that are used on the Lentz engine are oiled by gravity, while force-feed cylinder oil pumps feed oil directly to the bottom sides of the cylinders, obviating piston wear.

Reproduced herewith in this connection are indicator cards taken from the Galesburg (Ill.) engine already referred to. This engine was operating condensing at the time the test was made by Mr. C. T. E. Johnson, local superintendent of water-works.

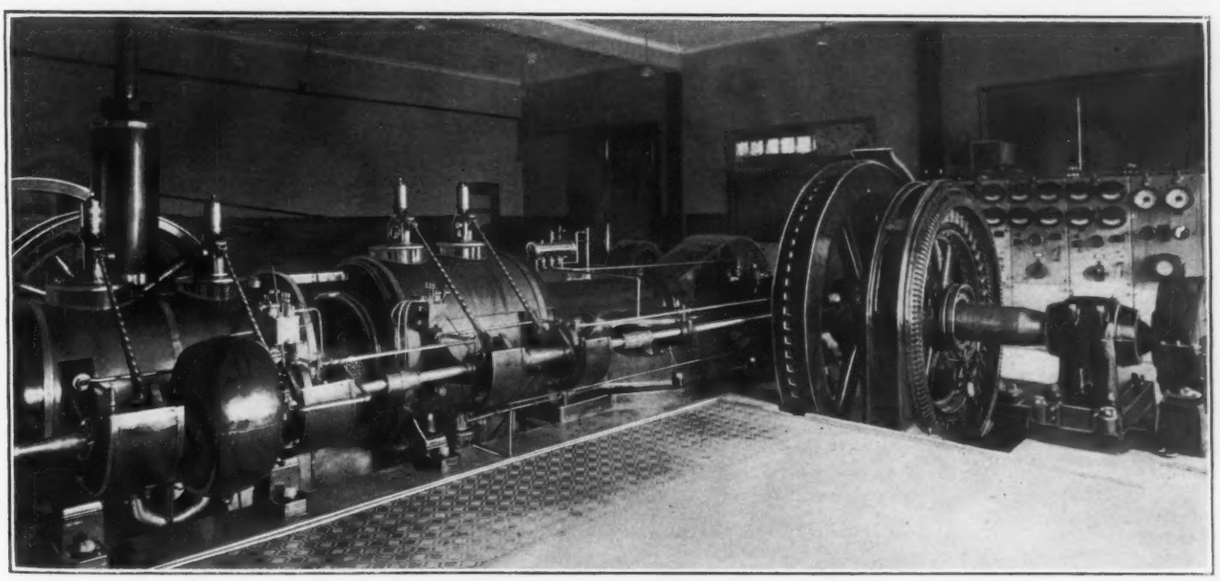


Fig. 4—250-hp Lentz-Type Poppet-Valve Engine at Casper, Wyo.

Industrial and Commercial News

The Week in Trade.

RESULTS of its annual canvass of manufacturers, financiers, railroad officials and other representative business men with regard to their views upon trade conditions, their causes and remedies, were made public this week by the National Association of Manufacturers, and a summary of the 10,000 answers received to the 20,000 inquiries sent out shows that business interests in the various sections of the country are united in the belief that political agitation is largely responsible for the unsatisfactory conditions that exist in general trade at the present time. The various remedies for relieving these conditions, classified in the order of their importance as shown by the canvass, were: Cessation of political agitation, cessation of tariff legislation, amendment or improvement to the Sherman Act, federal incorporation and regulation of trusts, more national and individual confidence, an improved system of banking and currency, governmental prosecution of the labor trust with all other illegal combinations in restraint of trade, and, finally, increased export trade and rehabilitation of the American merchant marine. Without doubt many of the so-called causes or restraining influences are largely exaggerated, both in their actual and their immediate influence upon the business situation. In any event, the tendency apparent this week in industrial circles to set aside excuses, give less attention to imaginary conditions and advance business in spite of the restraining influences which have always existed in more or less prominent form, is a step in the right direction. Mild improvement has been made in a number of lines during the week. The majority of steel mills are in active operation, and the volume of business is increasing, though profits are curtailed by low prices. Large contracts for pig-iron are pending, and the principal orders at present are coming from pipe manufacturers. Inquiries and orders for cotton goods are also expanding. Business failures for the week ended Nov. 23, as reported by *Bradstreet's*, were 293, as compared with 238 for last week, 212 for the corresponding week in 1910, 217 in 1909, 193 in 1908, and 258 in 1907.

The Copper Market.

THERE is a rather general belief at this writing that advance in copper prices has reached its limit for the present. The upward movement has been weakened by decrease of speculative interest in standard copper, and second hands are offering electrolytic freely, at concessions from the prices asked by the leading agencies. Consumers, therefore, are satisfied that there is no necessity for alarm over the present trend of the market, and are buying only for immediate requirements. While the producing element, with a view to influencing sales, presents the argument that stocks of copper are decreasing and that the supply is getting low, consumers still hold to their belief that there is plenty of copper to supply normal demand, and that slight price changes are unimportant since substantial increase will keep them out of the market more than ever. This attitude on the part of consumers is strengthened by a feeling that the recent advance has been too rapid to be permanent. Buying of copper abroad, while not especially active, is on an encouraging scale, and exports for the month, including Nov. 27, aggregate 24,231 tons. With a good export showing, prospects of a fair delivery to domestic interests, and the fact that November is a short month, there is a strong probability that the next report of the Copper Producers' Association will show a decrease in surplus stocks. Standard copper in New York on Monday was irregular, and the tone was weak. Activity in London was not very pronounced, but the market was strong, with an upward trend. With indications at present pointing to early improvement in general trade, the outlook for the copper industry is far brighter than it has been for some months past. The daily call on the Metal Exchange Nov. 27 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.80	13.10	....
November	12.80	13.10	12.95
December	12.87½	13.17½	13.02½
January	12.90	13.30	13.10
February	12.92½	13.10	13.00
March	12.92½	13.10	13.00

The London market, Nov. 27, was as follows:

	£ s. d.	£ s. d.
Standard copper, spot	59 3 9	59 5 0
Standard copper, futures	59 18 9	60 0 0

Extreme fluctuations for this year.

	Highest.	Lowest.
Standard	12.95c	11.57½c
London, spot	£59 5 0	£53 7 6
London, futures	60 0 0	54 0 0
Best selected	63 5 0	57 5 0

Industrial and Commercial Notes.

New York Edison Increasing Its Power Load.—Among private plants in New York City recently supplanted by central-station service was that in the Liberty Tower, one of the newer skyscrapers, opened for occupancy about a year ago. The contract which the owners have entered into with the New York Edison Company calls for an installation of 2500 incandescent lamps and 210 hp in motors for operating five elevators, three pumps and one sidewalk lift. The plant which formerly supplied the building was installed in a sub-basement cut in the solid rock when the building was erected, and represented an investment of about $40,000. It was estimated when the private plant was installed that its yearly output would be some 625,000 kw-hours, but actual consumption, it is said, has been 250,000 kw-hours per year. The showrooms of the New York Edison Company have been reporting a very satisfactory increase in orders for heating appliances since cold weather has become pronounced. Fifteen radiators were disposed of within the past two weeks, these being about 2 kw to 3 kw in capacity. One of the devices having a ready sale is the electric bar heater for mixing hot drinks. The heater comes in two sizes, three and five quarts respectively, and consumes about 990 watts.

Navy Contracts Awarded to Diehl Manufacturing Company.—The electrical turret-operating equipment for the new battleships *New York* and *Texas*, now building at the New York Navy Yard and the Newport News Shipbuilding & Dry Dock Company, respectively, will be furnished by the Diehl Manufacturing Company, of Elizabethport, N. J. The equipment for each ship consists of ten upper-hoist turret equipments at $14,935; ten lower-hoist motors and brakes at $7,482; ten rammer equipments at $9,293, and ten elevating equipments at $9,040, making, a total of $81,500. The Diehl company will furnish this apparatus for $77,500. The General Electric Company, which furnished similar equipment for the battleships *Florida* and *Utah*, was the only other bidder, and its price was $82,524.

One Thousand-Volt Direct-Current Railway for Mexico.—The Mexican office of Siemens-Schuckertwerke has closed a contract for the construction of a railway for the city of Pachuca, in the State of Hidalgo, Mexico. The first installation will comprise four 34-ton electric locomotives, two substations and overhead equipment. The line will be 17.4 miles long and be operated at 500 and 1000 volts, direct current, the equipment admitting of operation on either tension. The necessary energy will be transmitted by the Mexican Light & Power Company at 6000 volts, 50 cycles, three phase. The road will be used for city and suburban passenger traffic, and for hauling ore from silver mines.

Supreme Court Upholds Muskegon's Right to Issue Bonds for Municipal Plant.—The State Supreme Court has rendered a decision affirming that of the Circuit Court, which held that all of the proceedings for the issuance of $75,000 bonds by the city for the construction of a municipal lighting plant were valid. The action was brought by the Muskegon Traction & Lighting Company, which obtained a temporary injunction that was subsequently set aside by the Circuit Court.

Status of the Mechanics' Lien Law in Illinois.—Electrical supply dealers and contractors who do business in the State of Illinois will do well to take into account the rights of sub-contractors under the Illinois mechanics' lien law, following the refusal of the Supreme Court of that State on October 11 last to grant a re-hearing in the case of Kelly versus Johnson. Frederic P. Vose, of Chicago, who is an attorney-at-law and secretary of the Electrical Credit Association of that city, has prepared the following statement of the law as it is now declared to be: "The Illinois Supreme Court has already held that the only right to lien to which a sub-contractor for work, labor or material is entitled is derived from the contract between the original contractor and the owner, and that if such a contract provides there shall be no lien on the improved property for material and labor furnished by the original contractor, such contract is binding upon a sub-contractor, and a sub-contractor, where a lien has been waived in the original contract, has no lien for material or labor. The court now goes further and says, in the Kelly versus Johnson case, that the right to a lien under the original contract may be waived by the original contractor after the execution of such contract and that all sub-contractors under such original contract furnishing labor or material under contracts dated after a waiver of lien has been given will have no right to lien. It is also held that any law passed by the Legislature attempting to deprive the owner or the general contractor of the right to make contracts waiving the power to a lien would be unconstitutional. The point to be borne in mind seems to be that sub-contractors, in the ordinary course of business, may be presumed to have no right to place a mechanics' lien on a building for electrical or other construction work.

Colorado Municipality Cannot Enter a Partnership.—Judge Gamble, of the District Court of Boulder, Col., on Nov. 9 issued an order restraining the city of Longmont from building or becoming in any way interested in the construction, ownership or operation of an electric-light plant, as provided for in an ordinance adopted by the City Council last year. The city on Aug. 22 sold $46,000 of 5 per cent electric-light bonds. It appears that the appropriation for the construction of the municipal lighting and power plant was found insufficient, and a contract was entered into between the city and the Longmont Service Company, whereby the money was to be used for erecting a substation and distributing lines, while the Service company was to pay for laying water mains and all other necessary work outside the city limits. The Service company was to be reimbursed and to receive 10 per cent interest until the indebtedness was wiped out. The order was granted upon the application of the Northern Colorado Power Company, which alleged that the contract was illegal and void on the ground that a municipality cannot enter a partnership. The restraining order will stop all work for the present. The power company's contract to light the city of Longmont expires Dec. 1, and the company has applied for a renewal of the contract on a more attractive basis.

Foreign Trade Opportunities.—A recent consular report, containing South African notes, states that the Johannesburg municipality will place orders during the current year for a 3000-kw turbo-alternator with steam piping at an estimated cost of $75,000 and a 2000-kw converter to cost about $40,000. A boiler with economizer, superheater and draft apparatus, costing $35,000, has just been contracted for with Babcock & Wilcox, Ltd. The plan adopted by the Pretoria municipality for extension of the tramway system at a cost of $235,000 will, it is stated, involve the placing of car orders aggregating about $20,000. The Pretoria municipality is also about to enlarge its generating equipment by the addition of a 1000-kw turbo-generator and two boilers with accessories. The Bethlehem municipality (Orange Free State Province) will shortly place contracts for an 80-kw generator, two motor-driven boosters, a 260-cell storage battery, traveling cranes and switchboards.

Cities Service Company Buys Brush Electric Light & Power Company, of Galveston, Tex.—The Brush Electric Light & Power Company, which operates in Galveston, Tex., has been purchased by the Cities Service Company, the operating company for a number of the public utilities controlled by H. L. Doherty & Company. The Galveston property was controlled by the Galveston Gas Company, which was organized in Texas in Aug., 1856, to manufacture gas and electricity. The capital stock of the Brush company is $125,000. Its direct-current equipment totals 400 kw, and its alternating equipment about 5000 kva. The company recently obtained a new fifty-year franchise which is free from objectionable restrictions. The property is in good physical condition and a large part of it is new. The purchase price was about $150,000, and it is said that the Cities Service Company will pay for it with the proceeds of a sale of its preferred stock to a London banking house.

Pittsburgh, Shawmut & Northern Railroad Adopts Telephone Dispatching.—The Pittsburgh, Shawmut & Northern Railroad Company has placed an order with the Western Electric Company for equipment to be used in connection with the introduction of train dispatching by telephone on a part of its system. A switchboard is also to be furnished, thus giving the railroad its own telephone system. There will be six selector stations on the dispatching circuit, which is to be approximately 50 miles in length and will extend from St. Mary's, Pa., to Brookville, Pa. It is intended to have the train dispatcher located at St. Mary's. The telephone stations will for the present be ten in number. The selective and telephone apparatus will be of the most modern type and of Western Electric Company manufacture throughout.

Independent Telephone Interests in Northern Illinois.—It is reported that the interests in control of the Chicago Subway Company, which is closely affiliated with the Illinois Tunnel Company, the receivers of which operate the competing automatic telephone service in Chicago, are planning to purchase a controlling interest in the Interstate Independent Telephone & Telegraph Company, of Aurora, Ill., which is an independent company giving telephone service in a number of cities and towns in northern Illinois. The Interstate company, which is in the hands of receivers, gives long-distance connections to the Chicago competing company, and it is now proposed, apparently, that the two properties pass under the same ownership.

Increase in Hudson & Manhattan Railroad Fares.—On the plea that the company has not earned interest on its bonds, taxes and other fixed charges on the business thus far developed with a uniform 5-cent fare, the Hudson & Manhattan Railroad Company, which operates the subways between New York and New Jersey, has announced that, beginning Dec. 24, the rate between Jersey City and Hoboken and Sixth Avenue, New York, will be increased to 7 cents. This is 1 cent less than the existing rate by ferry and trolley between the water-front in New Jersey and uptown New York. The present rate of 5 cents between local stations in New Jersey and between local stations in New York will be maintained.

Southern Sierras Power Company.—The Southern Sierras Power Company has been organized with a capital of $5,000,000, and an authorized bond issue of $5,000,000, as a subsidiary of the Nevada-California Power Company. The company will erect a power plant at San Bernardino to operate in conjunction with present Bishop Creek plant of the Nevada-California company, supplying farming districts in southern California. D. A. Chappell, of Denver, is president, and T. S. Hayden, president of the Denver Union Water Company, is vice-president. The offices are in the Symes Building, Denver.

Detroit United Railways Reaches Agreement with City.—The Detroit United Railways has agreed to forfeit $5,000 per day, secured by a $1,000,000 bond, for each day that possession of the traction lines is withheld from the city after the latter has obtained legislative authority to operate them and has given a six months' notice of intent to purchase. A franchise covering this agreement has been prepared for submission to the Common Council of the city. This franchise, with all present rights of the company, would expire in 1924.

American "Z" Tungsten Lamps.—The American "Z" Electric Lamp Company, of New York, announces that it has issued a license to Kilburn, Brown & Company, of London, under which that firm is allowed the exclusive selling and manufacturing rights of "Z" tungsten lamps in the United States, and that the business will be conducted after Dec. 1 at its new offices and warehouse at 29 Lafayette Street under the style "American 'Z' Electric Lamp Company, Kilburn, Brown & Company, sole licensees."

Cheyenne Electric Railway Sold.—Eastern capitalists have, it is reported, purchased the Cheyenne (Wyo.) Electric Railway, which will be operated in conjunction with the Northern Colorado Power Company. W. J. Barker, now president of the latter company, will head the new company, which has applied for a new franchise.

Financial.

The Week in Wall Street.

PRICES in the New York market have been very irregular this week, and the volume of trading has been exceedingly light. The opening on Monday was strong, and some advances were made in the early trading, but reaction took place in the early part of the day, resulting in net declines for many of the active stocks. The general trend of business throughout the day was clearly of professional character. While the statement to Parliament of Sir Edward Grey, British Secretary for Foreign Affairs, on Anglo-German matters had no immediate influence on the market, since the importance of the Moroccan incident as a market factor disappeared some months ago, considerable interest was taken in financial quarters in the manner in which the delicate situation would be relieved. Further weakness developed in the market on Tuesday, and the nature of the day's proceedings was similar to that of Monday. The opening was slightly higher than on Monday, followed by a sharp decline, while in the last few minutes of trading general recovery took place, and the losses of the earlier part of the day were made up. A rise in call money rates on Monday to 3½ per cent was followed on Tuesday by an advance to 3¾, the highest figure thus far in the year. Rates in the local market on Nov. 28 were: Call, 3@3¾ per cent; ninety days, 3½@3¾ per cent. Foreign exchange experienced a sharp decline. Following Sir Edward Grey's speech, prices rose in the Berlin stock market, indicating that the statement had been favorably received. Interest is marked in the reorganization plan of the Metropolitan Street Railway, and Interborough-Metropolitan shares were strong in Tuesday's market. Transfer of gold to San Francisco and Canada in large quantities was made on Tuesday, and further shipments are expected before long. The quotations in the tables are those at the close Nov. 28.

NEW YORK.

	Nov. 21.	Nov. 28.	Shares Sold.		Nov. 21.	Nov. 28.	Shares Sold.
All. Cb.....	3¼	3¼*	1,200	Int. Met., pf.	47⅜	47	15,060
All. Ch., pf..	13¼*	13¼*	200	Mackay, Cos.	85½*	83	200
Amal. Cop..	64	64	128,820	Mackay C.,pf.	73	72½	210
Am. D. T...	33⅛*	33⅛*	———	Man. Elev...	136*	134	310
Am. Loco...	36	36	2,700	Met. St. Ry.	15*	15*	———
Am. Loco.,pf.	103¾*	102⅞	210	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	78*	78*	———	Steel, com...	63¾	64⅞	598,150
Am. T. & T..	140	139⅛	36,720	Steel, pfd...	109⅛	109¼	5,900
B. R. T....	78⅛	77¾	7,550	W. U. T....	78½*	77½	1,800
Gen. Elec....	155¾	154½	2,650	West'h, com.	66	65	1,708
Int. Met....	15½	15	14,400	West'h, pfd..	115*	113	———

PHILADELPHIA.

	Nov. 21.	Nov. 28.		Nov. 21.	Nov. 28.
Am. Rys.....	45¾	46¼	Phila. R. T.....	23½	23¾
El. Co. of A.....	11⅞	12	Phila. Elec.....	16	16
Elec. St. Bt'y.....	53½*	53½	Phila. Trac.....	84½	84½
Elec. St. Bt'y., pf..	30*	30*	Union Trac.....	51¾	52⅛

CHICAGO.

	Nov. 21.	Nov. 28.		Nov. 21.	Nov. 28.
Chi. City Ry.....	186*	186*	Com. Edison.....	133½	134½
Chi. Elev. Rys.....	30*	30*	Chi. Subway.....	⅜	½
Chi. Elev. Rys., pf..	94*	94*	Chi. Telephone.....	130¼	139¼
Chi. Rs., Ser. 1....	95*	95*	Nat'l Car.....	105*	105*
Chi. Rs., Ser. 2....	33*	33½	Nat'l Car, pfd.....	118*	118*

BOSTON.

	Nov. 21.	Nov. 28.		Nov. 21.	Nov. 28.
Am. T. & T.....	140	140¼	Mex. Tel.....	3*	3*
Cum. Tel.....	155	156½	Mex. Tel., pf.....	6½*	6½*
Edison	290	287	N. E. Tel.....	150	150
Gen. Elec.....	155½	155	W. T. & T.....	27½*	27½*
Mass. E. Ry.....	21⅞	21½	W. T. & T., pf....	107¼*	104¼*
Mass. E. Ry., pf....	95½	94			

*Last price quoted.
Shares sold for the week, Nov. 20 to Nov. 25.

Financial Notes.

Annual Report of Allgemeine Elektricitäts-Gesellschaft.—The annual report of the Allgemeine Elektricitäts-Gesellschaft of Berlin for the fiscal year 1910-11 shows that, after deduction of general expenses, taxes, interest on bonds and amounts written off, there remained a balance of approximately $5,550,000 available for dividends, as compared with $4,700,000 in the year preceding. After distribution of dividends, and in consequence of the large capital to be used for extensions of the factories, the liquid means of the company, some 45,000,000 marks (about $11,250,000), will undergo a reduction, in view of which it is intended to issue new debentures to the value of 30,000,000 marks at a suitable time. The company now owns property covering 270 acres, and owing to large increase in orders, both in hand and in prospect, it is now making plans for substantial extension of the Berlin factories, machine shops and small motor factories. There are 60,818 employees, of whom 5,454 are engaged at the factories in Vienna, Riga and Milan. During the year the company supplied turbo-generators and transformers numbering 92,470, with an output of 2,827,336 hp, which compares with 72,460 machines and 1,476,623 hp output in the preceding year. All of the products of the company have been in very good demand during the year. Orders for high-speed generators from 8000 hp to 15,000 hp for coupling to water turbines, three-phase motors with economic regulation for driving rolling mills and continuous-current motors for submarine boats were very numerous during the year. The new locomotive motors, particularly the single-phase type, have given excellent results. The high-tension factory produced apparatus and transformers for pressures up to 110,000 volts and for outputs exceeding 20,000 hp. Large numbers of turbo-generators and turbo-driven auxiliary machines were ordered for use on German and other foreign battleships. Among the largest turbo-units delivered were the following: To the Rheinisch-Westfälisches Elektricitäts-Werke, Essen, one 21,500-kva unit; two 16,000-kva units to the Oberschlesische and the Berliner Elektricitäts-Werke; two 12,000-kva units for Buenos Ayres, and one 9400-kva unit for the Königliche Bergwerksdirektion, Saarbrücken. Sales of arc lamps, which have lost some of their popularity abroad owing to success of the large metallic-filament lamps, were on about the same value as in the year before. Orders for meters and installation material were received in such large volume that they necessitated immediate enlargement of the workshops, and some of the departments of the company had to be transferred to rented premises. The meter sales during the year will more than double those in the year preceding. Sales of electric heating and cooking apparatus were also more than double those of the preceding year. The department for electric clocks has brought out new apparatus for wireless telegraph and for controlling purposes, also tachometers of every description. The marine department has designed new ship's telegraph apparatus, distance speed indicators and special switches for use on board ships. Inclosed installation material for rough industrial and agricultural work has also been developed during the year, and unprotected porcelain material has been designed to meet present-day requirements. Orders for high-tension cable have shown an increase. The manufacture of enameled wire has also expanded and the manufacture of insulating material capable of withstanding heat has progressed satisfactorily. All metal-working departments of the company have had larger outputs during the year. The sale of metallic-filament lamps increased 60 per cent. The report states that the useful life and strength of the lamps leave nothing further to be desired. The capacity of the electrical works erected during the year by the company aggregates 263,500 hp, as compared with 226,600 hp in the previous year. New plants and extensions are being constructed with an aggregate capacity of 492,000 hp. The most noteworthy feature of the year in the electric-railway branch of the company's business was the opening of the electric trial service on the Dessau-Bitterfeld line, with alternating-current equipment. The results of the trial were so satisfactory that the Prussian State Railway authorities at once decided to equip two long main-line tracks completely for electric traction. The company is paying considerable attention to welfare work among its employees.

To Issue More Capital Stock.—The Fitchburg Gas & Electric Light Company, of Fitchburg, Mass., has filed a petition with the Gas & Electric Light Commissioner requesting permission to issue 2,627 additional shares of capital stock with a par value of $50. The proceeds are to be used for paying off floating indebtedness caused by cost of extensions to the company's plant. The financial statement of the company on June 30, 1911, as filed with the Secretary of the Commonwealth, shows as follows:—Assets: Machinery, $883,353; land and buildings, $173,793; merchandise, material and stocks in process, etc., $95,967; cash and debts receivable, $69,993; money received on collateral, $3,271; unfinished construction, $48,026; miscellaneous equipment, $20,612; total, $1,295,015. Liabilities: Capital stock, $566,150; debts, $337,269; capital stock premium, $217,805; profit and loss, $170,520; guaranty fund, $3,271; total, $1,295,015.

Federal Light & Traction Company Notes.—Marked improvement continues to be shown in the earnings of the Federal Light & Traction Company, 60 Broadway, New York, which operates public utilities in New Mexico, Washington, Wyoming, Colorado, Arizona, Oklahoma, and Missouri, as described in these columns Nov. 4, 1911. The consolidated statement of earnings of the subsidiary companies for the month of October showed gross returns of $138,308, as compared with $127,343 in October, 1910, a gain of 8.6 per cent. Operating expenses for the month were $80,355, as compared with $72,457, an increase of 10.9 per cent, and net earnings were $57,953, as compared with $54,885 in the previous October, an increase of 5.6 per cent. In the ten months ended Oct. 31, 1911, gross earnings were $1,074,557, as compared with $986,214, a gain of 8.9 per cent. Operating expenses were $642,841, as compared with $576,817, an increase of 11.4 per cent, and net earnings for the period were $431,715, as compared with $409,398, an increase of 5.4 per cent. The earnings of the Trinidad Electric Transmission, Railway & Gas Company, which began operations Sept. 1, 1911, are included in the statement for the month of October but not in the statement covering the ten months. As a matter of fact, October earnings are not properly comparable with previous statements owing to changes in accounting methods, an entirely new system of accounting having been instituted in July, but the steady growth of both gross and net revenue is apparent. The company has secured a new twenty-year franchise at Rawlins, Wyo., carrying with it a contract for city lighting, upon very favorable terms. Day service has been established, and a campaign for motor load is in progress. A fifty-year franchise has been secured at Sheridan, Wyo., and a contract for sewerage pumping has been closed with the city of Albuquerque, N. M., running to maturity of the franchise. The company's new-business campaign for alternating-current lights and sign lighting alone is bringing in a new revenue of from $75,000 to $100,000 per annum. Gross earnings in the year ended Oct. 31, 1911, were $1,540,249, as compared with $727,927 in the year ended June 1, 1910. Operating expenses in these respective periods were $918,766 and $463,331, and net earnings were $621,482, as compared with $264,596.

Reorganization of New York Traction Companies.—Following the decision of the Court of Appeals that the Third Avenue Railroad Company can carry out the bondholders' plan of reorganization without the consent of the Public Service Commission, a meeting was held by the bondholders' committee to discuss the manner in which the reorganization will be effected. The old property of the Third Avenue Railroad Company will be immediately transferred to the new Third Avenue Railroad Company, and as soon as this transfer is made the issuance of new securities will follow. There are numerous minor modifications to be made, as the interest allowances, etc., have been accruing for the past eighteen months and these will have to be disposed of. The company will apply to the Public Service Commission for a formal order of approval, in accordance with the court's decree. The old securities of the railroad company consist of $16,000,000 of stock and $54,028,000 of bonds, or $70,028,000 in all. In the reorganization plan it is proposed to issue $16,590,000 of capital stock, $15,790,000 of 4 per cent refunding bonds and $22,536,000 of 5 per cent adjustment bonds, which, with the $5,000,000 of old first-mortgage bonds outstanding, would make $59,916,000 capitalization, or over $10,000,000 less than that of the old company. In view of this fact, it will be incumbent upon the Public Service Commission to grant the application of the company. The Metropolitan Street Railway Company made the first move to take advantage of the decision of the court in the Third Avenue reorganization case, and applied on Nov. 22 to the United States Circuit Court for a postponement of the sale of the property of the Metropolitan Street Railway, which was set for Nov. 23. The court granted a postponement of the sale of the property to Dec. 29. The Metropolitan bondholders will, it is believed, follow the example of the Third Avenue company and incorporate a new company to take over the property of the old concern after it has been bought in under foreclosure by the bondholders, who will be in a position to buy the property at the December date.

Consolidated Gas, Electric Light & Power Company's Income Increases.—The earnings of the Consolidated Gas, Electric Light & Power Company, of Baltimore, for the four months of the new fiscal year, beginning July 1, showed a material increase over those for the corresponding period of the previous year. This gain in income, it is explained, is due to the new business which the company has obtained during the first four months of the new year. The report issued a few weeks ago, covering the fiscal year ended June 30, 1911, showed that 5472 new customers had been secured during the twelve months, or an increase of 5.7 per cent over the gain in the previous year. It is stated that the increase in the four months of the new fiscal year of 1912 has been in proportion to the gain reported for the previous year. In this connection it is pointed out that the new business which has been obtained by the company has not been provided by newcomers to Baltimore, but is the result of the efficient campaign for additional customers which the company's solicitors have carried on throughout the city. This gain in new customers, it is said, has been in both the gas and electric lighting departments. The company proposes to maintain the activity for new business during the remaining months of the year, and the officials say that if they can extend their service in the months to come in as satisfactory a manner as they have been able to do in the four months of the new fiscal year, a most favorable record will have been established for 1912. The financial district is speculating as to what the directors of the company will do regarding the common-stock dividend, which is now on a 5 per cent basis. It was thought that the dividend would be increased to 6 per cent in September, but the directors failed to take the action predicted. There is a rather general opinion to the effect that the board will probably put the stock on a 6 per cent basis this month. During the past few weeks there has been considerable buying of the 4½ per cent bonds of the Consolidated Gas, Electric Light & Power Company. It is claimed that the demand for these bonds is due to the improved condition of the company's earning account.

Detroit Edison's New Stock Issue.—Following its decision to increase its capital stock from $9,000,000 to $15,000,000, as previously reported in these columns, the Detroit Edison Company is now offering to stockholders of record on December 9 the right to subscribe to $1,500,000 new stock at par to an amount of 25 per cent of their holdings. Payment may be made in full on Jan. 3, 1912, entitling the subscriber to immediate delivery of the stock paid for, or payments may be made in instalments, as follows: On Jan. 3, 1912, 50 per cent; on April 1, 1912, 25 per cent, and on July 1, 1912, 25 per cent. All payments must be made at the office of the company in New York.

Northern Ohio Traction Company Increases Dividend.—An extra dividend of one-quarter of 1 per cent on the common stock, payable Dec. 15 to holders of record Nov. 30, has been declared by the Northern Ohio Traction & Light Company. The regular quarterly dividend of three-quarters of 1 per cent, also payable Dec. 15, was recently declared. It is stated that the company will place the stock on a regular 4 per cent basis, beginning next year.

DIVIDENDS.

Brooklyn Rapid Transit Company, quarterly, 1¼ per cent, payable Jan. 2.

General Electric Company, quarterly, 2 per cent, payable Jan. 2.

Indianapolis Street Railway Company, semi-annual, 3 per cent, payable Jan. 2.

Northern Ohio Traction & Light Company, extra dividend, one-quarter of 1 per cent, payable Dec. 15.

REPORT OF EARNINGS.

AMERICAN LIGHT & TRACTION COMPANY.

Period		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
October,	1911.....	$367,641	$10,757	$356,884	.....	.....
October,	1910.....	356,685	11,126	345,559	.....	.....
CHATTANOOGA RAILWAY & LIGHT COMPANY.						
October,	1911.....	$83,698	*$49,247	$34,451	$20,198	$14,253
October,	1910.....	77,993	*42,746	35,247	18,545	16,702
MONTREAL STREET RAILWAY COMPANY.						
October,	1911.....	$442,393	$232,202	$210,191	$35,697	$174,494
October,	1910.....	386,688	205,750	180,938	31,998	148,939
PHILADELPHIA COMPANY.						
October,	1911.....	$1,645,808	$1,071,633	$775,891	$627,733	$148,158
October,	1910.....	1,649,891	988,597	846,277	605,694	240,583
SOUTHERN CALIFORNIA EDISON COMPANY.						
Yr., Sept.,	'11.....	$3,621,394	$1,769,453	$1,851,941	$1,333,464	$518,477
Yr., Sept.,	'10.....	3,302,210	1,622,498	1,679,712	1,202,180	477,532

*Including taxes.

General News

Construction News.

BAY MINETTE, ALA.—The installation of an electric-light plant in Bay Minette is under consideration. Hampton D. Ewing, president of the Bay Minette Land Company, is interested in the project.

SHADES MOUNTAIN, ALA.—The Shades Cliff Land Company, which is planning to develop 600 acres on Shades Mountain, is reported to be contemplating an electric railway extension, costing about $50,000, and taking over a 4-mile line already built. G. T. Brazleton, 2014 First Avenue, Birmingham, Ala., is president of the company; Robert L. Totten, of Birmingham, Ala., is engineer in charge.

MURFREESBORO, ARK.—E. L. Timmons, of Shawnee, Okla., it is reported, is contemplating building an electric-light plant in Murfreesboro.

CHICO, CAL.—The Chico Business Men's Association is considering the installation of a new street-lighting system in the business section of the city. It is proposed to erect electroliers, each carrying five lamps, to cost approximately $45 each.

COALINGA, CAL.—The Coalinga Water & Electric Company is extending its system to include the East Side field from the Good Luck property, where the line leaves the main power line. The transmission line will run through the Pleasant Valley Farming Company's property, thence through the property of the Coalinga Brick & Tile Company, and from there into Coalinga, making two separate lines into the city.

FRESNO, CAL.—The Fresno & Eastern Railroad Company, recently incorporated with a capital stock of $1,500,000, contemplates the construction of an electric railway, 75 miles in length, extending from Fresno to different points in this territory. Fayette M. Meiggs, of Oakland, Cal.; Albert B. Dodd, of San Francisco, Cal., and George J. Aldrich, of Audubon, N. J., are among the incorporators.

REDDING, CAL.—The Northern California Power Company has purchased all the land it needs for its proposed power plant on the Big Bend of Pit River from the Central Pacific Railway Company for $4,250. The deed also gives the power company a right-of-way through the railroad company's lands for its ditches, tunnels and pole lines in connection with its power development project. The Northern California Power Company has commenced work on power plant, which will involve an expenditure of about $4,000.000.

SAN DIEGO, CAL.—The Board of Supervisors has awarded the San Diego Consolidated Gas & Electric Company contracts to erect an electric-lighting system and supply electricity for street lamps in the City Heights and Normal Heights districts for a period of five years. Under the terms of the contract the company agrees to supply sixty-three 6.6 amp alternating-current arc lamps at the rate of $5 each per month in City Heights and seventeen lamps in Normal Heights at the same rate. Work will begin on the installation of the system at once.

MANITOU, COL.—Preliminary arrangements have been completed and work will begin at once on the construction of an aerial passenger railway from Manitou to the summit of Pike's Peak. E. A. Norton, of Manitou; F. R. Coffman and H. A. Lindsey are interested.

CLINTON, CONN.—Plans are being made by the Pond's Extract Company for the installation of an electric-light plant at its works. The new boiler house is nearly completed, a new smokestack is being placed, and estimates are being received for the equipment of an electric-light plant with sufficient output to light the entire laboratory.

TAKOMA PARK, D. C.—The Town Council, it is reported, has decided to install an electric light and power plant in Takoma Park. E. E. Blodgett is chairman of the committee to take charge of the matter.

DE LAND, FLA.—The City Council has entered into a contract with the De Land Electric Light, Power & Ice Company for lighting the streets of the city for a period of five years. The new contract provides for twenty-six new lamps.

FORT PIERCE, FLA.—The proposition to issue $15,000 in bonds for the construction of an electric light plant, it is reported, will be submitted to a vote of the people on Dec. 12. R. Whyte is Mayor.

OCALA, FLA.—The Florida Power Company has withdrawn its offer to supply electrical energy to the city of Ocala at the rate of 3 cents per kw-hour. The proposition was submitted to the town seven months ago and it has not yet received an answer. W. N. Camp is president of the company.

ORLANDO, FLA.—The Gulf Coast Fruit Association, which has a farm of eighty acres near Orlando, is reported to have awarded contracts for extensive improvements and extensions to its property to L. C. Lowe, of Huntington, W. Va., architect, and J. H. Braden, contractor, of Fullerton, Ky. The proposed work will include the erection of factories, construction of 100-mile canal, an electric railway 100 miles long, two power houses, two substations, ice and packing plants, twenty-six dwelling houses and several commission houses, the latter to be built in various cities. The company proposes to enlarge its farm to 4000 acres, to be drained by proposed canal.

CUTHBERT, GA.—The bonds recently issued by the city of Cuthbert for improvements to the municipal electric-light plant and water-works system have been sold, and steps will be taken to begin work at once on improvements to the plants.

JACKSON, GA.—The $12,000 bond issue recently voted by the city for improvements to the municipal plant has been sold. The proceeds will be used for the purpose of changing the equipment of the steam plant to utilize energy transmitted from the plant of the Central Georgia Power Company on the Ocmulgee River, near Jackson. Work will soon begin on the construction of the substation. It is expected to have the plant completed by Jan. 1, 1912.

JESUP, GA.—Bonds recently voted for the installation of the water-works system have been sold, and as soon as the location of the power house is definitely decided upon work will begin on construction of the system. Arthur Pew, of Atlanta, Ga., is engineer in charge.

JONESBORO, GA.—The City Council has decided to call an election to submit the proposition to issue bonds to provide funds to enlarge the municipal electric-light plant, water-works and sewer systems.

HAILEY, IDAHO.—The Kirkpatrick Brothers are considering plans, it is reported, for the installation of an electric-power plant on Silver Creek to supply electricity for lamps and motors in Picabe.

WALLACE, IDAHO.—Plans are being considered for the installation of an electric-power plant at the Iron Mountain mine, near Wallace, at a cost of about $100,000.

WENDELL, IDAHO.—Preparations are being made to erect a power plant at Thousands Springs. The interests in control of the National Copper Bank, of Salt Lake City, Utah, are said to be concerned in the project. The proposed plant will cost approximately $500,000 and will develop about 5000 hp. Lafayette Hanchett, of Salt Lake City, is one of the promoters.

CHICAGO, ILL.—The contract for furnishing and erecting operating machinery for lock gates of the canal lock adjacent to the power house near Lockport, Ill., has been awarded to the Klemp Simpson Company, of Chicago, Ill., for $4,140.

GALENA, ILL.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 4 for conduit and wiring system, gas-piping system and interior lighting fixtures at the United States post office and custom house at Galena, Ill., in accordance with drawings and specifications, copies of which may be obtained at the above office or of the custodian at Galena, Ill. James Knox Taylor is supervising architect.

PEKIN, ILL.—Plans are being prepared by the Pekin City Railway Company to extend its system in Pekin and for the construction of an extension to Tremont, Delavan, Hopedale, Boynton and Hittle.

AUBURN, IND.—The County Commissioners have engaged Mahurins & Mahurins, of Fort Wayne, Ind., architects, to prepare plans and specifications for a power plant.

KENDALLVILLE, IND.—The City Council has made arrangements with the Toledo & Chicago Interurban Railroad Company to furnish electricity to carry the peak load. The company agrees to furnish the service at 2¼ cents per kw-hour, and also offers to supply energy to operate the entire system at 1.80 cents per kw-hour with a sliding schedule down to 1 cent per kw-hour. The municipal plant is unable to meet the demands made upon it and is in need of extensive repairs.

LOGANSPORT, IND.—The Board of Public Works has awarded the contract for furnishing the new arc lamps to the General Electric Company, of Schenectady, N. Y., at $1,510.

OTTERBEIN, IND.—The Otterbein Light & Power Company, recently incorporated with a capital stock of $10,000, it is said, contemplates the construction of an electric-power plant to supply electricity for lamps, heat and motors. R. H. Holt, Lewis Leaming and R. W. Pearce are interested.

ALLISON, IA.—An election will be held Dec. 11 to submit to a vote the proposition to grant an electric-light franchise to Claud Mackey.

BOUTON, IA.—The Jones Electric Company, of Perry, Ia., is reported to have secured a contract to construct an electric-light and power plant in Bouton.

CORYDON, IA.—We are advised that the Town Council of Corydon, Ia., has called off the bids advertised for Dec. 5 for the reconstruction of the municipal electric-light plant, owing to a contemplated change in the plans. It is probable that bids will be called later on for smaller generators, driven by oil engines. The Iowa Engineering Company, of Clinton, Ia., has charge of the engineering work.

GALVA, IA.—Bids will be received by I. E. Baumgardner, town clerk, until Dec. 15 for the erection of building and installing equipment for an electric-light system in Galva. The Electric Engineering Company, of Sioux City, Ia., has charge of the engineering work.

GLIDDEN, IA.—The City Council has engaged Samuel C. Johnston, of Leon, Ia., to take charge of the construction of the proposed municipal electric-light plant in Glidden, for which bonds to the amount of $10,000 were recently voted. O. B. Moorhouse is city clerk.

KEOKUK, IA.—Plans have been completed by the Stone & Webster Engineering Corporation, of Boston, Mass., for the erection of the transmission line from the power plant at the Keokuk dam to St. Louis. The proposed line will be 167 miles long and will cost about $2,000,000. Work will begin at once on construction of the line. Electricity generated at the Keokuk plant will be distributed by the Mississippi River Distributing Company in St. Louis.

LAMONI, IA.—The installation of an electrolier lighting system is reported to be under consideration by the City Council.

OTTUMWA, IA.—The Ottumwa Gas Light, Heat & Power Company has been sold to the Western Utilities Company. The company will be reorganized and bonds to the amount of $750,000 issued for extensions and improvements to the plant.

SIOUX CITY, IA.—The City Council has voted to install a new power plant in the basement of the city hall and has authorized bids to be advertised for an electric generator and engine for the same, to cost approximately $3,000. The present plant supplies electricity for lighting the city hall, city jail and city detention hospital. The new plant will also light the new Carnegie library. The old boilers in the present engine-room will be removed and the room enlarged.

STORY CITY, IA.—A contract has been awarded for the installation of sixty-five electroliers, to be erected on Broad Street.

DEARING, KAN.—The Union Traction Company, it is reported, will submit a proposition to the Dearing Council for lighting the streets of the town with electricity.

LEAVENWORTH, KAN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 22 for installation of conduit and wiring system, lighting fixtures, etc., in the United States post office and custom house in Leavenworth, Kan., in accordance with plans and specifications, copies of which may be obtained at the above office or at the office of the custodian, Leavenworth, Kan. James Knox Taylor is supervising architect.

McLOUTH, KAN.—An electric-lighting system is being installed in McLouth by Moxley & Company, which has been granted a twenty-year franchise. The company also has a contract to light the streets of the city for a period of five years.

PARSONS, KAN.—Application has been made to the Board of City Commissioners by Frank Workman for an electric-light franchise in Parsons.

SOLOMON, KAN.—At an election held recently the proposition to issue $30,000 in bonds, the proceeds to be used for the installation of a municipal electric-light plant and water-works system, was defeated.

BARBOURVILLE, KY.—The Bon Jellico Coal Company, recently organized, has leased 1300 acres of rich coal lands in Whitley County and is preparing to open mines on same. The company proposes to install a complete electrical equipment to operate the mines and all shops and machines, and will also erect a spur railroad, 3 miles in length. Arthur Groves is president and E. B. Taylor, of Williamsburg, manager.

OWENSBORO, KY.—Messrs. Russell & Brewster, of Chicago, Ill., have secured the controlling interest in the Rural Home Telephone Company, which operates in Daviess, McLean, Hancock and Ohio Counties. The following officers have been elected: Theodore Tyler, of Chicago, president; W. B. McIllvaine, of Chicago, Ill., vice-president, and L. N. Birk, of Owensboro, Ky., secretary and treasurer.

RUSSELLVILLE, KY.—The City Council has rejected the proposition submitted by W. M. Case, of Clarksville, Tenn., to purchase the municipal electric-light plant for $25,000.

COVINGTON, LA.—W. J. Tracy, of Cleveland, Ohio, has been granted a franchise to construct an electric railway from Slidell to Houltonville, St. Tammany Parish. This line, it is said, is a link in a proposed railway between Slidell and Hammond, which will eventually be extended to Baton Rouge, La.

AUGUSTA, MAINE.—The Cienfuegos, Palmira & Cruces Electric Railway & Power Company, a Maine corporation, has voted to increase its authorized capital stock from $3,500,000 to $20,000,000.

ROCKLAND, MAINE.—The Rockland, South Thomaston & St. George Railway Company is contemplating the purchase of new storage batteries.

BOSTON, MASS.—Orders have been placed by the Edison Electric Illuminating Company of Boston with the General Electric Company, of Schenectady, N. Y., for one 15,000-kw turbo-generator set, to cost about $250,000. This is the second turbo-generator with a rating of 15,000 kw ordered by the Edison company within the past fifteen months, which will increase the turbine capacity of the company to 81,000 kw.

CHICOPEE, MASS.—The Board of Aldermen has voted to issue bonds to the amount of $96,000, the proceeds to be used for reconstruction of the municipal electric-light plant.

FITCHBURG, MASS.—The Fitchburg Gas & Electric Company has applied to the Massachusetts State Board of Gas and Electric Light Commissioners for permission to issue 2627 additional shares of stock, par value $50, the proceeds to be used to pay floating indebtedness incurred in making extensions to its plant. The new stock is to be offered at $85.

GREENFIELD, MASS.—The Massachusetts Northern Railways Company has acquired control of the Connecticut Valley Street Railway Company, of Greenfield, Mass.; Athol & Orange Street Railway Company, of Athol, Mass., and Gardner, Westminster & Fitchburg Street Railway Company, of Gardner, Mass., and the Templeton Street Railway Company, of Templeton, Mass. The new company contemplates the construction of railways connecting Miller's Falls and Orange and an extension to Winchendon, which will give a through line from Boston to Greenfield.

LEOMINSTER, MASS.—The special lighting committee is preparing plans for the installation of the new street-lighting system in Leominster. It is proposed to replace the 115 arc lamps now in use with about 575 tungsten lamps, most of them to be of 40 cp. The tungsten lamps will cost the town $15 each per year. The street-lighting service is furnished by the Leominster Electric Light & Power Company.

MALDEN, MASS.—The Malden Electric Light Company has submitted a proposition to the City Council offering to reduce the price of arc lamps from $100 to $86.56 each per year for all-night and every night service on a ten-year contract, instead of from $100 to $98 as stated in the issue of Oct. 28.

NORTH ADAMS, MASS.—Plans are being considered by the Merchants' Association for the installation of a new ornamental street-lighting system on Main Street. It is proposed to use ornamental lamp standards with tungsten lamp clusters.

SPRINGFIELD, MASS.—The City Council has appointed a committee to consider the question of municipal ownership of a lighting plant.

BATTLE CREEK, MICH.—The City Council has authorized the Mayor to appoint a committee to make investigations and secure data as to the cost of construction and maintenance of an electric plant to supply the city with electricity for lamps and motors. The committee will also select a site on which to erect such a plant.

CLARE, MICH.—The plant and holdings of the Milling Light & Power Company, of Clare, Mich., have been purchased by C. C. Field, of Detroit, Mich., a representative of the Consolidated Light & Power Company, which is building two dams on the Chippewa River and is planning to supply electricity to a number of small towns in this vicinity. J. L. Hudson, of Detroit, Mich., is president of the Consolidated company.

MUSKEGON, MICH.—The City Council has accepted the bid of the Grand Rapids-Muskegon Power Company to furnish the city with electricity for lighting the streets. Under the terms of the contract the company will furnish arc lamps at $57.50 each per year with all-night service and 60-cp incandescent lamps at $16 per year per lamp to burn all night. The city now pays $76 each for arc lamps and $12 each per year for 20-cp incandescent lamps. The city recently decided to build a municipal electric-light plant, for which bonds to the amount of $75,000 were voted. The installation of a municipal plant will be abandoned for the present.

EAGLE LAKE, MINN.—The Consumers' Power Company, it is reported, is considering the question of submitting a proposition to this village to supply electricity for lamps and motors. It is proposed to extend the transmission line from the company's plant at the Rapidan dam, near Mankato.

EVELETH, MINN.—The Council is reported to have adopted a resolution to call an election to submit the proposition for municipal ownership of a light, heat and power plant and water-works system to a vote.

MAYNARD, MINN.—At an election held recently the proposition to issue $5,000 in bonds, the proceeds to be used for the installation of an electric-light plant, is reported to have been carried.

MAZEPPA, MINN.—The City Council, it is stated, is considering the question of installing an auxiliary engine in the municipal electric-light plant. Either a steam or a gasoline engine will be installed.

MINNEAPOLIS, MINN.—The City Council is reported to have accepted the proposition offered by the Minneapolis General Electric Company to erect and maintain 137 ornamental lamps in the Bridge Square district.

MORTON, MINN.—The Wherland Electric Company, of Redwood Falls, which has been granted a franchise to supply electricity in Franklin, it is reported, contemplates extending its transmission lines to Morton in the spring.

PINE CITY, MINN.—The Eastern Minnesota Power Company, it is reported, is extending its transmission lines to Brahm, Grasston, Mora, North Branch, Harris, Princeton, Grandy and Isanti.

PLUMMER, MINN.—The Battery Company, of Milwaukee, Wis., is reported to have applied for a franchise to install an electric-light plant in Plummer. It is proposed to utilize the water-power of the Clearwater River to operate the plant.

SLEEPY EYE, MINN.—Bids will be received until Dec. 5 by H. C. Peterson, city recorder, for one 60-kw and one 75-kw, three-phase, 60-cycle, alternating-current generator with field rheostat and accessories.

WASECA, MINN.—The City Council has authorized the Water and Light Board to enter into a contract with the Consumers' Power Company, of Mankato, Mich., to supply electricity to operate the municipal electric system for a period of ten years at the rate of 4 cents per kw-hour; also to operate the water-works pump. Bonds have recently been issued to rebuild the distributing and lighting system. The Con-

sumers' Power Company is erecting a transmission line from its plant at the Rapidan dam, near Mankato to its plant at Cannon Falls, via Waseca, Faribault and Northfield.

BEATRICE, NEB.—The Nebraska-Iowa Public Service Company, recently organized, will take over the property of the Beatrice Electric Company, of this city, and eight other towns in Nebraska, Iowa and South Dakota. The company is successor to the Bullock Public Service Company and will control the electric systems in the following towns: Beatrice, Blue Springs, Wymore, Norfolk and Blair in Nebraska; Magnolia, Logan and Missouri Valley in Iowa, and Fairfax, S. D. E. A. Bullock, of Norfolk, Neb., is president of the company and Clyde Bullock, of Norfolk, is secretary.

NORFOLK, NEB.—The proposition to issue bonds to the amount of $75,000, the proceeds to be used for the installation of an electric-light plant and water-works system, will be submitted to a vote at an election to be held Dec. 12.

VIRGINIA CITY, NEV.—The County Commissioners have granted the Truckee River General Electric Company a franchise to erect its high-tension transmission line across Storey County.

DOVER, N. H.—The City Council is considering the question of installing a new street-lighting system. It is proposed to replace the arc lamps now in use with tungsten lamps. The Twin State Gas & Electric Company, which furnishes the street-lighting service, has agreed to install tungsten lamps on several streets for demonstration purposes. W. G. Meloon is manager of the company.

ATLANTIC CITY, N. J.—Work has commenced on the installation of the new ornamental lighting system for the Boardwalk. Ornamental lamp standards will be erected, which will carry festoons of incandescent lamps. The city has appropriated $30,000 for improvements to the system.

ALBANY, N. Y.—The Capital City Construction Company, of Albany, N. Y., has secured the contract for electric wiring the state hall, at $2,844.

HUDSON, N. Y.—The Red Hook Light & Power Company has applied for a franchise to supply electricity in Hudson.

LEWISTON, N. Y.—The Lewiston & Lake Ontario Shore Power Company has applied to the Public Service Commission, Second District, for permission to exercise franchises in the villages of Lewiston and Youngstown and the towns of Lewiston and Porter, and also for authority to begin construction of its plant and distributing system to supply electricity for lamps, heat and motors. The company proposes to purchase electricity from the Niagara, Lockport & Ontario Power Company. Permission is also asked to sell $25,000 in capital stock, the proceeds to be used to purchase right-of-way, erection of distribution system, etc. Substations will be located in Lewiston, Youngstown and Ransomville.

NEW YORK, N. Y.—The contract for installing a new engine and generator at the Manhattan Street Hospital, Ward's Island, N. Y., has been awarded to Frost & Sheldon, Albany, N. Y., for $6,285. Franklin B. Ware, of Albany, N. Y., is state architect.

NEW YORK, N. Y.—Bids will be received by Joseph Johnson, fire commissioner, until Dec. 5 for furnishing material and labor for the installation of a complete electric-lighting system in the quarters of engine company No. 33, located at 42 and 44 Great Jones Street, and in the quarters of engine company No. 33, located at 363 Broome Street, borough of Manhattan. Blank forms and further information may be obtained and plans and drawings may be seen at the office of the Fire Department, 157 and 159 East Sixty-seventh Street, Manhattan.

SENECA FALLS, N. Y.—Plans are being considered to organize a company under the name of the Seneca Falls Power Company for the purpose of consolidating the water-powers along the Seneca River in Seneca with the object of establishing a central power plant. The company will be composed of the fifteen power owners along the river in Seneca and includes all the large manufacturing establishments in the village. The only expense in developing the water-power will be the construction of one large power house in case one large lock is used, or two or three smaller stations if a larger number of locks are utilized. It is expected that the construction work will not exceed $100,000. Ernest G. Gould is interested in the company. M. J. Barnes, engineer, has been making investigations in connection with the project.

OXFORD, N. C.—The Board of Town Commissioners has granted the North State Hydro-Electric Company a franchise to supply electricity in Oxford. Under the terms of the franchise the company agrees to supply electricity for lighting the streets of the city for a period of twenty-three years and five months at the rate of $60 per arc lamp per year and incandescent lamps at $18 each per year. The city now pays $75 per lamp per year for arc lamps and $35 each per year for incandescent lamps. The company has purchased the plant and holdings of the Oxford Water & Electric Company. Charles E. Johnson, of Raleigh, N. C., is president of the company.

SELMA, N. C.—Arrangements are being made for the construction of a new electric-light plant and water-works system in Selma.

TRYON, N. C.—The Hoke-Hill Real Estate & Investment Company has purchased 300 acres of land and has an option on 5000 acres near Tryon. It is said that the company will develop the property for residential and agricultural purposes. The company, it is reported, proposes to construct a hydroelectric power plant to supply electricity for lamps and motors. Investigation of water-powers is being made by William Farr, of Asheville, N. C., and F. G. Rogers, of Greenville, S. C., engineers. D. M. Hoke, of Greenville, S. C., is president of the company.

MINOT, N. D.—The City Commissioners are reported to have entered into a contract with the Consumers' Power Company to supply electricity to light the city.

PORTAL, N. D.—It is reported that negotiations are under way between the officials of Bowbells and parties interested in the local electric-light system whereby electricity for operating the system in Portal will be furnished from the Bowbells plant.

CLEVELAND, OHIO.—The contract for the construction of the addition to the municipal electric-light plant has been awarded to D. W. McGrath for $5,294. H. S. Holton is director of public service.

CLEVELAND, OHIO.—A resolution has been introduced in the City Council recommending the installation of a municipal conduit system. It is proposed that the city build the system and rent space to all telephone, telegraph and electric lighting companies. Some time ago the Council passed ordinances requiring the companies to place all their wires underground, stipulating that a certain number of miles be put in conduits each year. It is said that the companies are not living up to the provisions of the ordinance.

CONVOY, OHIO.—At an election held Nov. 7 the proposition to construct an electric-light plant to be owned and operated by the municipality was carried. W. F. Henney is village clerk.

EAST YOUNGSTOWN, OHIO.—The Mahoning & Shenago Railway & Light Company has been granted a franchise by the Village Council to double-track its car line through East Youngstown to the village limits.

HOOD RIVER, ORE.—The City Council has granted the Hood River Railway & Power Company a ten-year contract for lighting the streets of the city. The Pacific Power & Light Company has the present contract. It is understood that new company has made a great reduction in the price for the service.

McMINNVILLE, ORE.—Bids will be received by the city of McMinnville until Dec. 3 for the sale of bonds to the amount of $30,000, the proceeds to be used for improvements to the water and light systems. A. C. Chandler is city recorder.

PORTLAND, ORE.—The City Council has granted the Portland Railway, Light & Power Company a franchise to extend its electric railway on Sandy Boulevard from East Seventy-second Street to the city limits.

PORTLAND, ORE.—The executive board has authorized the city auditor to advertise for bids for lighting the streets of the city, which are not now served by the lighting system of the Portland Railway, Light & Power Company. Under the contract which the company holds with the city it refuses to make extensions for lamps more than 1200 ft. beyond the present installations. It is said that the Mount Hood Railway & Power Company will submit proposals to light the districts not covered by the present contract.

WOODVILLE, ORE.—The Rogue River Electric Company, of Medford, Ore., is reported to have secured a contract to install an electric-light plant in Woodville.

ALLENTOWN, PA.—The City Council has granted the Lehigh Valley Transit Company a franchise to build an electric railway from Eighth Street and Hamilton Street across the Eighth Street Bridge to Ninth Street and thence to the city limits.

CHURCHVILLE, PA.—The citizens of Churchville and Richboro are negotiating with the Philadelphia Suburban Gas & Electric Company, of Wyncote, Pa., to extend its system to this section to supply electricity for lamps and motors to these towns. The plant of the company is located near the Jenkintown station.

GREENSBURG, PA.—Preparations are being made by the West Penn Electric Company to extend its transmission lines from Greensburg to Saltsburg and New Alexandria. The Saltsburg Electric Company and the New Alexandria Company, recently incorporated as subsidiary companies of the West Penn Electric Company, have been granted franchises by the boroughs of Saltsburg and New Alexandria to supply electricity for lamps and motors.

PITTSBURGH, PA.—An ordinance has been introduced to the City Council granting a francihse to the Keystone Light Company, which has applied for permission to extend its transmission lines from the North Side to the wards in the old city of Pittsburgh. The ordinance provides for a maximum charge of 4 cents per kw-hour for electricity and the payment of 2½ cents of its gross earnings to the city.

WILLIAMSPORT, PA.—The electric-lighting and steam-heating plant and laundry building at the Williamsport Hospital was destroyed by fire recently, causing a loss of about $30,000.

HONEA PATH, S. C.—The Board of Public Works is reported to have awarded the contract for the construction of the proposed electric-light plant and water-works system to Cothran & Cothran, of Greenwood, S. C., engineers, to cost approximately $50,000. John F. Monroe is chairman of board.

FREEMAN, S. D.—It is reported that it is proposed to organize a co-operative company for the purpose of installing an electric-light plant in Freeman.

WOONSOCKET, S. D.—The City Council has granted the Shuler Electric Company a franchise to construct and operate an electric-light

plant in Woonsocket. The street-lighting system will include about forty lamps. The company will establish a twenty-four-hour service and will supply electricity at the following rates: For the first 25 kw-hours, 18 cents per kw-hour; from 25 to 50 kw-hours, 17 cents; from 50 to 75 kw-hours, 16 cents, and above 75 kw-hours, 15 cents.

JELLICO, TENN.—Preparations are being made by the Jellico Electric Light, Heat & Power Company for extensive improvements and extensions to its plant, including the installation of a direct-connected unit of 300 hp, consisting of engine and generator. Contract has been awarded for the erection of smokestack 103 ft. high, 4 ft. 6 in. in diameter. A 200-hp boiler was recently installed in the plant.

TRENTON, TENN.—The contract for construction of a municipal electric-light plant and water-works system has been awarded to the Allen Engineering Company, of Memphis, Tenn., for $17,233. R. C. Houston, 1634 Exchange Building, Memphis, Tenn., is engineer.

DALLAS, TEX.—The capital stock of the Dallas Automatic Telephone Company has been increased from $500,000 to $700,000.

FORT WORTH, TEX.—The Forth Worth Southern Traction Company is planning to erect three new substations, to be equipped with rotary converters, alternating-current and direct-current, step-down transformers, switchboards, etc.

FORT WORTH, TEX.—The Northern Texas Electric Company is offering $3,500,000 in capital stock and $5,500,000 in bonds, the proceeds to be used for extensions and improvements to its system. The company is a holding company and owns the stock of the Northern Texas Traction Company, which operates street railways in Forth Worth, Tex., and also an interurban electric railway between this city and Dallas, a distance of 33 miles. The Northern Texas Electric Company also owns the Fort Worth Southern Traction Company, which is constructing an electric railway from Fort Worth to Cleburne, 30 miles distant.

GALVESTON, TEX.—The Cities Service Company has announced the purchase of the plant and holdings of the Brush Electric Light & Power Company, of Galveston, Tex., which was controlled by the Galveston Gas Company. It is understood that the price paid for the property was about $1,500,000. In the issue of Nov. 11 this plant was reported to have been sold to the Newman interests of New Orleans, La.

HAMLIN, TEX.—The Hamlin Electric Light & Power Company, recently incorporated, is reported to be planning to establish a plant in Hamlin, to cost approximately $10,000.

LAREDO, TEX.—The Laredo Electric Railway Company is contemplating the purchase of a gas engine direct-connected to a 400-kw, 2300-volt generator.

BURLINGTON, VT. — The Electric Light Commissioners have awarded the contract for the installation of a new 750-kw turbo-generator set and condenser in the municipal electric-light plant to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for $20,500. The city is to furnish the foundation and the intake water pipe from the lake. The cost of building the foundation and the intake pipe is estimated at about $3,000, making the total cost about $24,000.

CENTRALIA, WASH.—Machinery has been received for the new power plant of the Centralia Light & Traction Company. Arrangements have been made with the Eastern Railway & Lumber Company to supply steam to operate the new plant.

EPHRATA, WASH.—A company is being organized under the name of the Ephrata Electric Company for the purpose of building an electric plant to furnish electricity for lighting the city. Work will soon begin on construction of the proposed plant. The capital stock of the company is placed at $10,000.

SEATTLE, WASH.—The new power plant of the Pacific Coast Power Company at Derringer, on Lake Taps, near Auburn, was placed in service on Nov. 11. Electricity generated at the plant has been contracted for by the Seattle Electric Company, for distribution in Seattle, affording the company two hydroelectric generating plants, the other being located at Electron. The Seattle company has closed down its steam generating plant at Georgetown, as well as its steam plant on Post Street; the latter will be held for service in case of emergency. Through permission granted by the Public Service Commission of Washington the Seattle Electric Company has reduced the price for electricity for lamps in Seattle, to take effect immediately. Under the new schedule the rates are as follows: For the first 60 kw-hours, 7 cents per kw-hour and all consumed above that amount 4 cents per kw-hour, with a minimum charge of $1 per month. Under the old schedule the rates were 9½ cents per kw-hour for the first 20 kw-hours, 8½ cents for the second 20 kw-hours, 7½ cents for the third 20 kw-hours and 5 cents for all over 60 kw-hours, with a discount of 10 per cent for prompt payment. The new rates are the same as those charged by the municipal electric plant.

BRILLION, WIS.—The contract for the installation of an electric-light and power system in the plant of the Brillion Iron Works, in Brillion, has been awarded to the Acker Electrical Company, of Sheboygan, Wis. The equipment includes a generator and oil engine, one 20-hp motor and five 5-hp motors and switchboard. The plant will be equipped with tungsten lamps.

HATFIELD, WIS.—It is reported that the La Crosse Water Power Company, of La Crosse, Wis., has been granted permission by Judge Sanborn, at Madison, Wis., to repair the damaged portion of the dam at Hatfield. The cost of the work is estimated at $150,000.

MERRILL, WIS.—Plans are being considered by the Merrill Railway & Lighting Company for extending its railway system to Lake View. The company is considering the trackless trolley system.

MILWAUKEE, WIS.—The contract for a condenser for a garbage incinerator in the Third Ward has been awarded to the Westinghouse Machine Company, of Pittsburgh, Pa. The Allis-Chalmers Company, of Milwaukee, Wis., secured the contract for turbine and auxiliary apparatus. Total cost of contract awarded is $15,092.

NEENAH, WIS.—Preparations are being made by the Wisconsin Traction, Light, Heat & Power Company to supply electricity for lamps and motors in West Neenah.

SUPERIOR, WIS.—The contract for construction of the power station of the Great Northern Power Company in this city has been awarded to Emil Sedlachek, of Superior. The new station will be located at the corner of Logan Avenue and Twenty-eighth Street and will be 60 ft. x 40 ft. A new transmission line along the Wisconsin side of the St. Louis River from the hydraulic power plant at Thomson to Superior will also be erected. The new power station will supply power for both Superior and Duluth in case of accident to the line on the Duluth side of the river.

TWO RIVERS, WIS.—The City Council is contemplating increasing the output of the municipal electric-light plant and water-works system. The cost of the work is estimated at about $25,000.

WEST SALEM, WIS.—The village of West Salem has petitioned the Wisconsin Railroad Commission to issue a declaration of convenience and necessity which would give the right to another lighting company to operate in West Salem. The present plant is considered inadequate to supply the service required.

CHEYENNE, WYO.—The property of the Cheyenne Electric Railway Company, with a twenty-two-year franchise, has been purchased by an Eastern syndicate, headed by W. J. Barker, president of the Northern Colorado Power Company, of Denver, Col. The price paid for the system is understood to be about $115,000.

BASSANO, ALTA., CAN.—The Bassano Electric Power & Traction Company has awarded a contract to Gorman, Clancy & Grindley for the construction of power house and electric railway from Bassano to the large Canadian Pacific Railroad irrigation, 5 miles in length. Orders have been placed for material for the railway. S. E. Whiting, of Bassano, is interested in the traction company.

EDMONTON, ALTA., CAN.—Plans are being considered by the City Commissioners for extensions and improvements to the electric-lighting system.

INNISFAIL, ALTA., CAN.—The Council is reported to be contemplating the installation of an electric-light plant in Innisfail.

LETHBRIDGE, ALTA., CAN.—Bids are being asked by the City Commissioners for additional equipment for the power plant of the municipal tramway system in Lethbridge.

LETHRIDGE, ALTA., CAN.—By-laws appropriating $450,000 for the installation of a street-railway system in Lethbridge next year will be submitted to the ratepayers at an election to be held Dec. 11. Of the proceeds $300,000 will be used for the construction of the street railway and the remaining $150,000 will be utilized for extensions to the power plant. If the propositions are carried contracts for the work will be awarded early in the year.

KAMLOOPS, B. C., CAN.—In the report submitted by Dutcher & Maxwell to the City Council in regard to the proposed hydroelectric power plant on Barrier River, it is estimated that 2000 hp could be developed at a cost of $190,000.

VANCOUVER, B. C., CAN.—The contract for construction of a water-power plant on Punledge River, Vancouver Island, for the Canadian Collieries, of Dunsmuir has been awarded to Grant, Smith & Company, of Vancouver, at $500,000. The proposed plant will develop about 12,000 hp, which will be utilized for the company's railway and mines.

VIRDEN, MAN., CAN.—The Mayor and Town Council would like to receive propositions for the installation and maintenance of an electric light and power plant within the limits of the town. Further information may be obtained on application to J. F. C. Menlove, secretary and treasurer.

ST. JOHN, N. B., CAN.—It is understood that an agreement has been reached between the Council committee and the St. John Railway Company which provides for a substantial reduction in the rates for electrical service now charged by the company. Under the new schedule the rates for energy for motors are said to be as follows: For less than 5 hp, $65 per horse-power per year; from 25 to 30 hp, $50; from 30 to 100 hp, $42.50; 100 to 200 hp, $40; above 200 hp, $37.50. For electricity for lamps the rate is 13½ cents per kw-hour up to 1000 kw and 10 cents for all above that amount, with a discount of 25 per cent in both cases.

DARTMOUTH, N. S., CAN.—The property of the Dartmouth Gas, Electric Light, Heating & Power Company is reported to have been purchased by F. B. McCurdy & Company. It is expected that the property will be taken over by the Nova Scotia Power Company, whose plant will be located on the Mersey River, 80 miles from Halifax. The price paid for the plant is understood to be about $75,000.

HARRISTON, ONT., CAN.—Plans are being considered for the installation of an electric street-lighting system in Harriston. The proposition will probably be submitted to a vote of the ratepayers.

KINGSTON, ONT., CAN.—The proposition to secure electrical energy from the transmission system of the Hydroelectric Power Commission for the city of Kingston will be submitted to the ratepayers at an election to be held in January.

LINDSAY, ONT., CAN.—Surveys are being made for an electric railway to connect Port Hope, Peterboro, Omemee, Lindsay and Orillia. It is planned to connect the proposed railway at Port Hope with a line from Montreal to Toronto. Electricity for operating the proposed system may be obtained from Niagara Falls. The Canadian Northern Railway Company is reported to be interested in the project.

LONDON, ONT., CAN.—The farmers of London Township are contemplating securing electrical service from the Hydroelectric Power Commission. A petition has been presented to the commission to submit prices for the service.

LONDON, ONT., CAN.—The London & Lake Erie Railway Company has appointed a committee to confer with the Hydroelectric Power Commission to secure estimates of cost of energy from the transmission system of the commission to operate an electric railway between London and Port Stanley.

LONDON, ONT., CAN.—It is reported that preparations are being made for the construction of the radial railway between London and Sarnia. Plans, it is said, are being prepared for the construction of a large hydroelectric plant on the Aux Sables River at Rock Glen, in West Williams Township. It is proposed to build an 80-ft. dam which, it is understood, will be erected at a point where there is already a natural waterfall that has been utilized for water-power purposes to operate mills in the township.

SUDBURY, ONT., CAN.—The City Council has granted Louis La Forest a franchise to build an electric railway to Copper Cliff.

WELLAND, ONT., CAN.—The City Council is negotiating with the Welland Electrical Company with a view of purchasing the plant to be owned and operated by the municipality. If the system is taken over by the city, electricity for operating it will be secured from the Hydroelectric Commission transmission system.

MONTREAL, QUE., CAN.—The Montreal & Southern Counties Railway Company is building an extension from McGill Street, Montreal, to Richelieu, 14 miles from St. Lambert. The company is also making preparations for the construction of a railway from St. Lambert to Waterloo, a distance of 69 miles, during 1912.

New Industrial Companies.

THE BUFFALO MOTO VEHICLE SERVICE COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $100,000 by W. R. Huntley, J. H. Vail and C. R. Huntley, of Buffalo, N. Y. The company proposes to manufacture, repair and deal in motor vehicles.

THE COPEMAN ELECTRIC STOVE COMPANY OF MISSOURI, of St. Louis, Mo., has been incorporated with a capital stock of $30,000 by Allan Kannedy, C. A. Tiles and John F. Carr. The company proposes to buy and deal in patents, electrical devices, etc.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, Ill., has been incorporated by William Low, Thomas Stacey and William B. Walrath. The company is capitalized at $60,000 and proposes to manufacture and deal in electrical apparatus, appliances, etc.

THE GENERATING LIGHT & MOTOR COMPANY, of Camden, N. J., has filed articles of incorporation with a capital stock of $125,000 for the purpose of manufacturing machinery, motors, etc. The incorporators are: J. J. Brady, F. West, of Philadelphia, Pa., and G. D. Connelly, of Camden, N. J.

THE GREATER NEW YORK TRANSIT BUILDING COMPANY, of New York, N Y., has been incorporated by C. T. Harvey, R. B. Holton, and R. S. Harvey, of New York, N. Y. The company is capitalized at $50,000 and proposes to construct electric railways, elevated railroads, etc.

GURLITT-BRAUN-DAVIS CORPORATION, of New York, N. Y., has filed articles of incorporation with a capital stock of $25,000 for the purpose of manufacturing and dealing in motor vehicles, etc. The incorporators are: H. Gurlitt, D. S. Davis, Jr., and V. C. Bogardus, of New York, N. Y.

THE KOOTENAI POWER CONSTRUCTION COMPANY, of Wilmington, Del., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $600,000. The incorporators are: W. J. Maloney and N. P. Coffin, of Wilmington, Del.

THE MARINE ELECTRIC COMPANY, of Louisville, Ky., has been incorporated by E. C. Thirwell, H. A. Tepel and C. G. Thirwell. The company is capitalized at $5,000 and purposes to operate a machine shop for electrical repairs.

THE ERNEST H. MEEKS ELECTRICAL COMPANY, of Norfolk, Va., has been incorporated with a capital stock of $30,000 for the purpose of doing a general electrical supply business. The officers are: Ernest H. Meeks, president; J. J. Collins, vice-president, and E. T. Meeks, secretary and treasurer.

THE METEOR AUTOMOBILE COMPANY, of Mount Vernon, N. Y., has been incorporated with a capital stock of $50,000 to manufacture motors, engines, motor vehicles, etc., by F. A. Kateley, A. F. Gescheidt and J. Emmeluth, of Mount Vernon, N. Y.

THE MORGAN STEEL JACKET REINFORCED BUILDING FOUNDATION COMPANY, of East Orange, N. J., has been incorporated by C. G. Geyer, F. E. Ruggles and L. Matthews, all of East Orange. The company is capitalized at $125,000 and proposes to do a general mechanical and electrical engineering business.

THE MOTOR STARTING COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $1,000,000. The incorporators are: L. E. Wales, of Wilmington, Del.; L. E. Replogle and L. W. Cooper, of Indianapolis, Ind.

THE NATIONAL CONDUIT MACHINE COMPANY, of San Francisco, Cal., has been incorporated with a capital stock of $100,000 by H. R. Berry, J. C. Campbell and G. E. Weaver.

THE NEW ERA MANUFACTURIIG COMPANY, of Jersey City, N. J., has been incorporated by W. W. Bender, H. O. Coughlan, of New York, N. Y., and H. T. Lette, of New York, N. Y. The company is capitalized at $125,000 and proposes to manufacture electric stoves, sadirons, kitchen utensils, etc.

THE PARIS AUTO STARTER COMPANY, of Paris, Ill., has been incorporated by Frank C. Fishback, E. B. Brooks and Paul P. Shutt. The company is capitalized at $10,000 and proposes to manufacture electric starters, automobile devices, etc.

THE PERFECTION STORAGE BATTERY & LIGHTING COMPANY, of Chicago, Ill., has been granted a charter with a capital stock of $50,000 to deal in electric generators, automobile appliances, etc. The incorporators are: Carl E. Winters, George B. Lyons and John W. Hake.

THE SORENSEN SMOKE CONSUMER COMPANY, of Jersey City, N. J., has been incorporated by Charles E. Johnson, Olaf Anderson and Charles Orenson, all of 15 Exchange Place, of Jersey City, N. J. The company is capitalized at $50,000 and proposes to manufacture smoke consumers and fuel economizers.

THE STANDARD BOILER WATER PURIFIER COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $50,000. The incorporators are: G. W. Weller, Jr., H. Knock and M. J. Dain, of Pittsburgh, Pa.

THE THERAPEUTIC LAMP COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing electric lamps, appliances, etc. The incorporators are: W. A. Soles, M. C. Worth and J. Becker, of New York, N. Y.

THE TUNGSTEN ELECTRIC SIGN & SCENE COMPANY, of Mansfield, Ohio, has been incorporated with a capital stock of $5,000 by George H. Lowrey and others.

TURK & BROWN, INC., of Rochester, N. Y., has been incorporated by S. H. Brown, Alfred H. Brown, both of 139 Park Avenue, Rochester, N. Y., and John F. Turk, 252 Main Street, Hornell, N. Y. The company is capitalized at $10,000 and proposes to manufacture motors, engines, machinery, vehicles, etc.

THE UNITED ELECTRIC SUPPLY COMPANY, of Marion, Ohio, has filed articles of incorporation with a capital stock of $10,000. The incorporators are A. J. Berry and others.

THE UNITED HYDRO-ELECTRIC POWER COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 for the purpose of doing a general contracting business and electrical work of all kinds. The incorporators are: F. B. Schanne, F. M. Livingston, of New York, N. Y., and J. C. Williams, of Brooklyn, N. Y.

THE WISHART-DAYTON AUTO TRUCK COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 to manufacture motor vehicles. The incorporators are: R. A. Inch, S. E. Wishart and J. B. Smith, of New York, N. Y.

New Incorporations.

LOS ANGELES, CAL.—The Appleton Land, Water & Power Company has been incorporated with a capital stock of $300,000 by E. N. Greenleaf, H. M. Brown, A. G. Stepper and others.

FLORENCE, COL.—Articles of incorporation have been filed for the Fremont & Interurban Railway Company with a capital stock of $125,000 by D. F. Foot, J. V. McCandless, H. A. Hicks, Charles Roach and W. K. Hurd. The company proposes to build interurban railways extending from Florence to Rockvale, Williamsburg, Coal Creek, Lincoln Park, Portland, Hardscrabble irrigation district and Concrete.

WILMINGTON, DEL.—The British-American Light, Heat & Power Company has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $6,000,000 and the incorporators are: N. P. Coffin, E. E. McWhinney and W. J. Maloney, of Wilmington, Del.

SALMON, IDAHO.—The Lemhi Power Company has filed articles of incorporation with a capital stock of $76,000. The company proposes to operate in Lemhi County. The officers are: C. L. MacKenzie, president; Edward Riggs, vice-president, and Ralph Irwin, secretary.

WALLACE, IDAHO.—The Long Valley Light & Power Company has been incorporated with a capital stock of $100,000 to build a hydro-

electric power plant on the North Fork of the Payette River, to develop about 4365 hp. The company proposes to supply electricity for lamps and motors in Rosebury, Crawford, Lardo and Thunder City. Walter C. Clark, of the Bunker Hill & Sullivan Mining Company, of Wardner, Idaho, is president of the company.

SHERIDAN, IND.—The Sheridan Water, Light & Heat Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are: J. L. Vickery, Perley Weaver, J. A. Branson, J. G. Antrim and Fred Beauchamp.

CENTRAL CITY, IA.—The Wapsipinicon Power Company has been incorporated with a capital stock of $30,000 by Fred J. Cross, Andrew Kasper and Oscar R. Barber.

NEW ORLEANS, LA.—Articles of incorporation have been filed for the El Salto Power Company with a capital stock of $300,000 by Monte M. Lémann and David W. Pipes, Jr.

PORTLAND, MAINE.—The Western Washington Power Company has been incorporated with a capital stock of $25,000 to acquire water-powers and lands, etc., in the State of Washington and elsewhere. C. M. Drummond is president and W. B. Drummond treasurer, both of Portland, Maine.

PORTLAND, MAINE.—The Western Utilities Company has filed articles of incorporation with a capital stock of $500,000 to construct and operate a plant for the generation of gas and construct dams, etc., for the production of power of all kinds. C. E. Eaton is president and T. L. Croteau treasurer, both of Portland, Maine.

BUCKLEY, MICH.—Articles of incorporation have been filed for the Duck Lake Power Company by Harlin Brown, David E. Wynkoop and Ralph Wynkoop. The company is capitalized at $16,000 and proposes to supply electricity in the villages of Buckley, Sherman and Mesick, where franchises have been secured. The company owns 140 acres of land at the outlet of Duck Lake, where it has established a hydro-electric plant.

RENO, NEV.—Articles of incorporation have been filed for the Nevada Valley Power Company with a capital stock of $2,500,000. The company proposes to build a hydroelectric power plant on the Truckee River to develop about 4000 hp. The directors are: A. D. Ayers, H. B. Danforth, A. A. Smith, of Reno, Nev., and others.

JERSEY CITY, N. J.—The Panama Tramways Company has filed articles of incorporation with a capital stock of $750,000 to construct and operate tramways in the Republic of Panama. The incorporators are: L. H. Gunther, B. S. Mantz and J. R. Turner, all of Jersey City, N. J.

LAKEWOOD, N. Y.—The Western New York Electric Company has been granted a charter with a capital stock of $10,000. The company proposes to operate in the villages of Lakewood, Ashville, Panama, Celoron and Falconer and the towns of Busti, Harmony and Ellicott. The directors are: Albert S. Price, Frank W. Bullock, George L. Maltby, William H. Reynolds, Almet N. Broadhead, Sheldon B. Broadhead and William A. Broadhead, of Jamestown.

LEWISBURG, OHIO.—Articles of incorporation have been filed for the Lewisburg Lighting Company by D. L. Gaskill, A. C. Robeson, J. M. Bickel, W. T. Fitzgerald and Z. T. Dorman. The company is capitalized at $5,000.

WAGONER, OKLA.—Articles of incorporation have been filed for the Wagoner Electric & Gas Company with a capital stock of $1,500 by H. K. Herbst, W. H. Stueve and Emil T. Gunther.

EUGENE, ORE.—The Eugene Belt Line & Interurban Railway Company has been incorporated with a capital stock of $250,000 to build an electric railway to connect Eugene, Springfield, Coburg and Junction City. The incorporators are Lawrence Harmon and E. R. Ernsberger.

ALLENTOWN, PA.—The South Whitehall Electric Light & Power Company has been incorporated with a capital stock of $5,000. The incorporators are: Charles N. Wagner, of Allentown, Pa., treasurer; R. P. Stevens and Charles M. Walter, both of Allentown.

CURWENSVILLE, PA.—The Anderson Creek Electric Company has been granted a charter with a capital stock of $5,000. George L. Benner, of Curwensville, Pa., is treasurer.

HARRISBURG, PA.—Charters have been granted by the State Department to the Lehigh Valley Light & Power Company, the Hanover Light & Power Company, of Hanover, Pa., and the Salisbury Electric Light & Power Company, of Salisbury, Pa.

HARRISBURG, PA.—Charters have been granted by the State Department to the following companies: The Edison Electric Company, of Topton, Pa.; the Longswamp Township Electric, of Reading, Pa.; the Maiden Creek Township Electric Company, of Maiden Creek, Pa.; the Maxatawny Township Electric Company, of Maxatawny, Pa.; the Richmond Township Electric Company, of Richmond, Pa.; the Edison Electric Company, of Kutztown, Pa., and the Edison Electric Company, of Fleetwood, Pa. Each company is capitalized at $5,000, and the incorporators are: Walter A. Rigg, George L. Roller and Harry Reigel, of Reading, Pa.

WEST PITTSTON, PA.—The Garden City Electric Company has been granted a franchise with a capital stock of $5,000. The directors are: J. A. McMillan, 114 Exeter Street, West Pittston, Pa., treasurer; W. S. Tompkins and Lewis Jones, of West Pittstown, Pa.

JOHNSTON, S. C.—The Electric Light, Ice & Fuel Company has been incorporated with a capital stock of $20,000 by F. M. Boyd and B. S. Boyd.

SPRINGFIELD, S. C.—The Springfield, Salley & Wagener Telephone Company has been incorporated by L. M. Mins and W. D. Black. The company is capitalized at $10,000.

KNOXVILLE, TENN.—The Knoxville Power & Light Company has been incorporated with a capital stock of $500,000 by Asbury Wright, R. M. Jones, E. G. Oates, Abraham Rosenthal and Walter McCoy. The company is a subsidiary of the Eastern Tennessee Power Company and will operate under a franchise recently granted by the municipality to the latter company. The Knoxville company will distribute electricity generated at the plant of the Eastern Tennessee company on the Ocoee River at Parkville. The transmission line is being constructed and will be ready for operation by Jan. 1, 1912. The company will also supply electricity in Chattanooga, Tenn.

DALLAS, TEX.—The Hancock Electric Company has been incorporated with a capital stock of $6,000 by W. L. Hancock, A. Hyman and J. B. Adoue, Jr.

DEL RIO, TEX.—The City Ice & Electric Company has been incorporated with a capital stock of $40,000 by C. G. Foulks, J. A. Raman and W. H. Wolff.

FORT WORTH, TEX.—The Fort Worth & Southwestern Railway Company has been chartered with a capital stock of $400,000 by W. D. Morton, L. A. Wright, J. P. Parr, of Glenrose, Tex.; D. C. Morris, of Walnut Springs; W. M. Shuler, of Waco, and others.

HAMLIN, TEX.—Articles of incorporation have been filed for the Hamlin Electric Light, Heat & Power Company with a capital stock of $10,000 by W. W. Johnson, W. S. Whaley and H. A. Knight.

JOURDANTOWN, TEX.—The Atascosa Ice, Water & Light Company has been incorporated with a capital stock of $15,000 by T. P. Zanderson, B. B. Daugherty, W. M. Avent and others.

McKINNEY, TEX.—Articles of incorporation have been filed for the Union Telephone Company with a capital stock of $75,000 by H. W. Head, C. A. Shock and C. B. Dorchester.

BRATTLEBORO, VT.—Articles of incorporation have been filed for the New Hampshire Power Company, under the laws of the State of Maine, with a capital stock of $15,000,000 for the purpose of development of extensive water-powers in central New Hampshire. The company is said to have secured options on property which will give it control of the flowage of the greater part of the Black Water, Sugar, Mascoma, Smith, Warner and Contoocook Rivers in Merrimack, Sullivan, Hillsborough and Grafton Counties. Numerous storage reservoirs, it is said, will be formed by the erection of dams at various points, which will be utilized to generate electricity to be supplied to manufacturing plants in New Hampshire and Massachusetts. It is estimated that about 100,000 hp can be developed. The officers are: Robert C. Bacon, of Brattleboro, Vt., president; Clarence E. Eaton, Portland, Maine, treasurer, and James E. Manter, of Portland, Maine, clerk.

PLEASANT RIDGE, VA.—The Back Bay Telephone Company has been granted a charter with a capital stock of $5,000. The officers of the company are: Charles T. Moore, of Pleasant Ridge, Va., president; T. F. Williams, of Princess Anne, Va., vice-president, and C. W. Dawley, of Pleasant Ridge, secretary.

SEATTLE, WASH.—The Sound Electric Company has been granted a charter with a capital stock of $10,000. The incorporators are: E. Ellsworth, H. Schacht and Edward Ellsworth.

SEATTLE, WASH.—Articles of incorporation have been filed for the Highland Park & Lake Burien Railway Company by W. H. Coughlin, 302 American Bank Building, Seattle, Wash.; William H. Murphy, James R. Stirrett and J. R. McLaughlin. The company proposes to build an electric railway from Seattle to Highland Park and Lake Burien, a distance of 8 miles.

MORGANTOWN, W. VA.—The Monongahela & Marion Railway Company has been granted a charter by the Secretary of State. The company is capitalized at $50,000 and proposes to build a street railway between Morgantown and Fairmont. The incorporators are: John Madigan, M. E. Fetty, Parker S. Johnson, Sanford Barrickman and John E. Price, all of Morgantown, W. Va.

Personal.

MR. ANSON M. HOLCOMB, formerly instructor at Cornell University, has been appointed assistant professor at the Case School of Applied Science.

PROF. W. S. FRANKLIN, of Lehigh University, will present a paper on Dec. 5 before the Schenectady A. I. E. E. Section entitled "Fundamentals of Electrostatics."

MR. S. M. BUSHNELL, of the Commonwealth Edison Company, Chicago, has been appointed chairman of the central-station heating committee of the commercial section of the National Electric Light Association.

MR. F. P. CUMMINGS, of the electrical department of the Denver Gas & Electric Light Company, has been made general superintendent of the Montgomery (Ala.) Light & Water Power Company, where his ability and enthusiasm assure him success.

MR. H. L. WALTHERS, formerly manager of the Yreka Railroad, is now manager of the Siskiyou Electric Power & Light Company,

Yreka, Cal. He has charge of the plants recently acquired from the Rogue River Electric Company, with headquarters at Medford, Ore.

MR. P. B. SAWYER, general manager of the Des Moines Electric Company, Des Moines, Ia., has been appointed manager of the Union Electric Company, of Dubuque, vice Mr. L. D. Mathes, who resigned to accept the post of general manager of the Montgomery (Ala.) Traction Company.

MR. JOHN HAYS SMITH, formerly editor of *The Electrical Age,* and of the *Electric Club Journal,* and until recently associated with the Allegheny County Light Company, of Pittsburgh, Pa., has been appointed assistant commercial engineer for The Milwaukee Electric Railway and Light Company.

MR. A. H. FLEET, formerly expert electrical specialist for the Bureau of Construction and Repairs of the United States Navy, and more recently shop engineer of the Southern Railway, has joined the naval-apparatus staff of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

MR. W. F. RABER, manager for H. M. Byllesby & Company of the Pueblo (Col.) railway and lighting properties, has also been appointed manager of the plants of the Colorado Electric Light & Power Company at Canon City and at Skagway in the Cripple Creek district, recently acquired by the Chicago firm.

MR. LAWRENCE A. COLEMAN, assistant secretary of the United Electric Light & Power Company, New York City, was married Nov. 22 to Miss Florence E. Miller, of New York. After his return from a short honeymoon spent at Atlantic City, Mr. Coleman's many friends showered him with felicitations.

MR. A. F. TRAVER has been appointed superintendent of the Denver Gas & Electric Light Company, with supervision of the gas, steam-heating and electric departments, filling the position made vacant by the resignation of Mr. Dostal. Mr. Traver's promotion is well merited and is viewed with favor by his associates.

DR. C. P. STEINMETZ delivered two lectures recently before the engineering students of the University of Illinois. The subjects were "Unexplored Fields in Engineering" and "The Nature of Electrical Energy." The audience at each lecture thronged the lecture-room of the Physics Building, in which the lectures were given.

MR. C. A. TUPPER will address the Milwaukee South Side Civic Association, Dec. 6, on the subject of harbor plans for Milwaukee. Mr. Tupper recently completed an extended investigation and trip among the principal harbors of Europe, and makes the interesting assertion that no city abroad which he visited can boast the superb natural water fronts of Milwaukee and Chicago.

MR. W. H. WISSING, formerly manager of the commercial department of the Union Electric Light & Power Company, of St. Louis, and more recently vice-president of the Central Station Development Company, Cleveland, has accepted the management of the new-business department of the Sierra & San Francisco Power Company, with offices in the Wells-Fargo Building, San Francisco.

MR. WALTER CLYDE JONES, a state senator from one of the Chicago districts, addressed the Electric Club of Chicago on Nov. 22 on "The Initiative and Referendum." Senator Jones, who is a member of the club and rather closely affiliated with electrical interests by reason of legal and business associations, is a candidate for the Republican nomination for Governor of Illinois. He pointed out, in earnest and vigorous fashion, the value of the initiative and referendum to all honest public-utility enterprises.

MR. P. B. SAWYER, general manager of the Des Moines Electric Company, of Des Moines, Ia., has been appointed manager of the Union Electric Company, of Dubuque, Ia., succeeding Mr. L. D. Mathes, who has resigned to become manager of electric-service and street-railway properties in Montgomery, Ala. Mr. Sawyer will take hold of the Dubuque property about the first of the year, and will have charge of both the central-station and the street-railway service of that city.

MR. C. N. DUFFY, comptroller of The Milwaukee Electric Railway & Light Company, delivered an address on the topic of "Civic Advertising" before the Advertisers' Club of Milwaukee on Wednesday evening, Nov. 22. Mr. Duffy's remarks were confined to the broader aspects of his subject. He contented himself with arousing the enthusiasm of his audience, to whose professional abilities he left the working out of details of a campaign to further the interests of the Wisconsin city. His remarks received hearty applause from the large number of interested persons present.

MR. EDWARD H. JOHNSON was a speaker at the fifth annual dinner of the Capt. John Ericsson Memorial Society of Swedish Engineers given at the Engineers' Club on Nov. 25. In introducing him Mr. Robert Lundell referred to Mr. Johnson as a pioneer in the electrical field who had been instrumental in bringing the electrical industry to its present state, and recalled his connection with Edison, Bergmann, Sprague and others. Mr. Johnson had much of interest to tell his audience in regard to the early days of electrical engineering. He referred at length to Mr. Thomas A. Edison, of whom he has been an intimate friend for forty-one years and with whom he was associated in business for many years. Mr. Johnson was the first president of the Edison Electric Light Company, which was founded on Oct. 16, 1878, and at that time had offices at 65 Fifth Avenue, New York City.

MR. DAY BAKER, New England manager of the General Vehicle Company, Boston, Mass., is the proud recipient of a near-diploma from Thomas A. Edison, in the shape of a photograph of the king of inventors bearing the following handwritten inscription: "I want to commend the conscientious, intelligent efforts you are making, which are materially assisting in bringing about the day in which the electric vehicle in our cities will become more common than the horse." Mr. Baker was recently elected permanent chairman of the Boston Electric Vehicle Club, and is giving a great deal of time during the winter to lectures upon electric-vehicle transportation. Recent invitations have been accepted to address gatherings at the Worcester Polytechnic Institute branch of the American Institute of Electrical Engineers, at Brown University, Providence, R. I., Tufts College, Boston, and at the conventions of the National Foundrymen's and Metal Workers' associations. Much good is being accomplished in arousing popular interest in electric automobile commercial and pleasure vehicle equipment and service, and all makes of machines are treated impartially in the larger interests of the industry's growth. Many Boston church and society gatherings are displaying an interest in the campaign against the horse and gasoline car.

Trade Publications.

SIGN FLASHERS.—The Reynolds Electric Flasher Manufacturing Company, 617 West Jackson Boulevard, Chicago, has just issued Bulletin No. 17, describing thermotype flashers, and Bulletin No. 16, describing transformers. The thermotype flasher is used extensively in window signs or for small signs of every description, where one, two or three lamps are used. The transformers described are for use with the tungsten lamp.

CUTLER-HAMMER PUBLICATIONS.—The Cutler-Hammer Manufacturing Company, of Milwaukee, has just published a number of new bulletins. No. 10½ describes new multiple-switch starting rheostats made in standard sizes from 10 hp to 150 hp for 110-volt, 220-volt and 500-volt direct-current service. New types of switches are used on these starters. No. 18 describes squirrel-cage primary-resistance motor starters, made in capacities from 5 hp to 30 hp for 110-volt, 220-volt and 440 500-volt circuits. Bulletin 2145 describes a new multiple-switch starter which, in addition to no-voltage release, is equipped with two new-type single-pole overload circuit-breakers. A compound multiple-switch starter and speed regulator is described in Bulletin 2260. This is made in capacities from 10 hp to 200 hp and combines in one panel starting and regulating rheostats. The apparatus described in Bulletin 2270 is like that of Bulletin 2260, except that the main-line knife switch and fuses are mounted on the panel so as to facilitate installation. This is called a compound universal motor starter and speed regulator.

BUSINESS NOTES.

THE MUTUAL ELECTRIC & MACHINE COMPANY, Wheeling, W. Va., has just completed additions to its plant which will practically double its facilities. The office has been moved into the new building, and the address is now 59-16 Eighteenth Street.

PASS & SEYMOUR, SOLVAY, N. Y., will move their Chicago branch from its present quarters to 700 West Jackson Boulevard on December 1. This move is made necessary to obtain additional space to take care of increasing Western business. The new quarters will have some three times the space of the former location.

ENGINEERING BOOKS.—The book department of the Engineering News Publishing Company has been purchased by the McGraw-Hill Book Company, 239 West Thirty-ninth Street, New York. This adds to the list of the McGraw-Hill Book Company a number of important standard treatises, primarily in the field of civil engineering. The transfer of this business was made on Nov. 6.

HOSKINS MANUFACTURING COMPANY.—The Hoskins Manufacturing Company, of Detroit, manufacturer of electric furnaces, pyrometers and heating appliances, has opened an Eastern office at 30 Church Street (Room 1036, Hudson Terminal Building), New York City. Mr. E. L. Smalley, formerly factory superintendent for the Hoskins company, is in charge of the new office, with the title of Eastern representative.

ICE-MAKING PLANTS FOR CENTRAL STATIONS.—Among recent sales of ice-making plants to central stations by the York Manufacturing Company, York, Pa., are the following: 60-ton plant to Ware County Light & Power Company, Waycross, Ga.; 120-ton plant to Consolidated Ice & Power Company, Valdosta, Ga.; 40-ton high-pressure side and 15-ton freezing and distilling system to Point Pleasant Water & Light Company, Point Pleasant, W. Va.,; 40-ton plant to Colon Electric, Ice & Supply Company, Colon, Canal Zone.

KERR STEAM TURBINES.—The Kerr Turbine Company, Wellsville, N. Y., has in active service over 700 of its machines, aggregating more than 50,000 hp, and more unfilled orders are now booked than at any previous time in the history of the company. Although its plant has been materially enlarged, a night shift has been necessary for the past two and a half years. Among most recent orders for electrical service are two 75-kw and one 35-kw lighting set to the American Shipbuilding Company for the new steamer *City of Detroit,* and two 75-kw lighting sets for water-works service in the city of Chicago.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

ALABAMA LIGHT & TRACTION ASSOCIATION. Secretary, Geo. S. Emery, 11 N. Royal St., Mobile, Ala.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City. The Council meets the first Friday of every month.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Honorary secretary, Ralph W. Pope; acting secretary, F. L. Hutchinson. Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

AMERICAN ELECTRIC RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia.

AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York.

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ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, N. T. Wilcox, Lowell, Mass.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, F. D. Morris, 323 Hagerman Building, Colorado Springs, Col.

ELECTRIC CLUB, CHICAGO. Secretary, N. E. Obright, 1500 American Trust Bldg., Chicago. Meets every Wednesday noon, 303 Wabash Ave.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, Harvey Robinson, 124 West 42d St., New York. Meetings, fourth Tuesday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

ELECTRIC TRADES ASSOCIATION OF PHILADELPHIA. Secretary, J. W. Crum, 1334 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

FLORIDA ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, H. C. Adams, West Palm Beach, Fla.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, J. V. Zartman, Indianapolis, Ind.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Chas, Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England. Next meeting at Berlin in 1913.

IOWA ELECTRICAL ASSOCIATION. Secretary, A. W. Zahm, Mason City, Ia.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

LOUISIANA ELECTRICAL ASSOCIATION. Secretary, W. H. Bower Spangenberg, 627 Poydras St., New Orleans, La. Meets third Monday of each month.

MAINE ELECTRICAL ASSOCIATION. Secretary, Walter S. Hyman, Waterville, Maine.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, T. C. Gordon, Little Falls, Minn.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, N. J. Cunningham, Springfield Gas & Electric Co., Springfield, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next annual convention at Detroit, Mich., June 25-27, 1912.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Next annual convention at Seattle, Wash., June 9-15, 1912.

NATIONAL ELECTRIC LIGHT ASSOCIATION, CANADIAN SECTION. Secretary, T. S. Young, 220 King St. West, Toronto, Can.

NATIONAL ELECTRIC LIGHT ASSOCIATION, GEORGIA SECTION. Secretary-Treasurer, H. M. Corse, Columbus Railroad Company, Columbus, Ga.

NATIONAL ELECTRIC LIGHT ASSOCIATION, MISSISSIPPI SECTION. Secretary, A. H. Jones, McComb City, Miss.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEBRASKA SECTION. Secretary-Treasurer, S. J. Bell, David City, Neb.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW ENGLAND SECTION. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION, PENNSYLVANIA SECTION. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

NATIONAL ELECTRIC INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Bldg., Chicago.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary, R. Sweetland, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1913.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Joseph B. Ware, Grand Rapids, Mich.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, L. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. I. E. Sanborn, Ohio State University, Columbus, Ohio.

ORDER OF REJUVENATED SONS OF JOVE. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Bldg., Chicago, Ill.

PITTSBURGH ELECTRIC BOOSTER CLUB. Recording Wattmeter, O. R. Bombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings, fourth Monday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. B. Moore, 39 Trinity Place, Boston, Mass. Monthly meeting, first Saturday of each month, at the Massachusetts Institute of Technology, Boston.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, D. G. Fisher, 1316 Commerce St., Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. G. Reel, Kingston, N. Y.

VERMONT ELECTRICAL ASSOCIATION. Secretary-Treasurer, A. B. Marsden, Manchester, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 135 Monroe St., Chicago, Ill. Next annual meeting Jan. 23-35, 1912.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1 each year.

WIRELESS INSTITUTE. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, George Allison, Stephenson Building, Milwaukee, Wis. Next annual meeting, Milwaukee, January, 1912.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 21, 1911.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,008,998. VAPOR ELECTRIC LAMP; P. H. Thomas, Montclair, N. J. App. filed Feb. 9, 1904. Mercury vaporization is retarded so as to prevent it from dominating a red-ray-producing gas.

1,009,025. CONTROLLING VAPOR ELECTRIC DEVICES; P. H. Thomas, Montclair, N. J. App. filed Feb. 9, 1904. A plurality of condensing chambers for the mercury for causing the circulation of a non-condensable red-ray-producing gas.

1,009,035. INSULATING MATERIAL FOR EMBEDDING ELECTRICAL CONDUCTORS; L. E. Barringer, Schenectady, N. Y. App. filed Feb. 5, 1906. Composition of calcium hydrate, silica and asbestos, steam-hardened.

1,009,059. TROLLEY DEVICE; J. H. Finch, Jr., West Roxbury, Mass. App. filed Dec. 28, 1910. Cam-slotted support for the harp, to avoid "jumping."

1,009,061. APPARATUS FOR MERCURIAL DECOMPOSITION OF ALKALINE CHLORIDES; R. Frank, Grunewald, Germany. App. filed Jan. 30, 1911. Movable cathode type. Ribbed drums move the mercury over the bottom of the compartments.

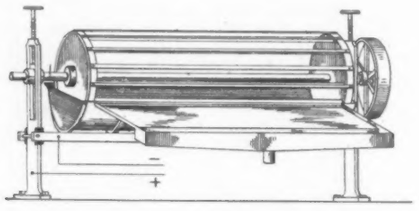
1,009,080. AUTOMATIC SWITCHING APPARATUS; F. B. McBerty, New Rochelle, N. Y. App. filed Sept. 11, 1908. Selector switch for automatic telephone exchange.

1,009,106. RECEIVING APPARATUS; H. Shoemaker, Jersey City, N. J. App. filed Nov. 3, 1909. Selective and protective system for wireless telephony and telegraphy.

1,009,120. INCANDESCENT ELECTRIC-LAMP SOCKET; A. Weber, Schenectady, N. Y. App. filed Oct. 1, 1906. Two-part porcelain base and terminals for keyless sockets.

1,009,129. METALLIC-FILAMENT LAMP; O. Birnbaum, Vienna, Austria-Hungary. App. filed Nov. 8, 1910. The filaments are kinked and connected adjacent to the leading-in point to prevent overheating.

1,009,133. ELECTROLYTIC APPARATUS; H. Croston, New York, N. Y. App. filed July 22, 1909. A scraper moves the mercury electrode; NaCl decomposition.



1,009,143.—Electrical Precipitator and Amalgamator.

1,009,143. ELECTRICAL PRECIPITATOR AND AMALGAMATOR; J. Frey, San Francisco, Cal. App. filed Nov. 18, 1910. A cylindrical cage anode is rotated in a trough containing the mercury cathode. For gold recovery, etc.

1,009,162. SWITCH FOR SPARKING DEVICES; F. J. Marrington, Fort Dodge, Ia. App. filed March 6, 1909. For multiple-cylinder internal-combustion engines.

1,009,166. RAIL BOND; H. Milliken, New York, N. Y. App. filed Feb. 15, 1910. Vertically arranged looped strands of wire forming a thin, flat body.

1,009,172. ELECTRIC SNAP SWITCH; J. G. Petersen, Hartford, Conn. App. filed Feb. 1, 1911. Indicator, rotary wall type.

1,009,182. POLYSTATION LINE CIRCUIT; G. Ritter, Stuttgart, Germany. App. filed Feb. 12, 1910. Grounded two-wire circuit. Non-interfering party telephone or telegraph.

1,009,190. TELEPHONE TRUNKING SYSTEM; C. A. Simpson, Chicago, Ill. App. filed April 9, 1908. Means for charging the storage battery of a private branch exchange over the two-wire trunk circuit.

1,009,229. MOTOR-STARTER SWITCH; W. S. Evans, Newark, N. J. App. filed Dec. 30, 1910. Automatic short-circuiting for three-phase induction motors.

1,009,285. PORTABLE BURGLAR ALARM; W. Crowley, Philadelphia, Pa. App. filed Feb. 14, 1911. Relatively hinged contacts are fastened to a doorframe and door respectively.

1,009,291. ARC-LAMP ELECTRODE; G. Elgy, Treptow, Germany. App. filed Oct. 22, 1909. A carbon shell and a core of a mixture of carbon, phosphoric acid, fluorspar and water glass.

1,009,309. RAILWAY SIGNALING; L. F. Howard, Edgewood Park, Pa. App. filed Sept. 8, 1909. The plane of vibration of a polarized beam is rotated by means controlled by the condition of a track section.

1,009,310. DYNAMO-ELECTRIC MACHINERY; A. S. Hubbard, Belleville, N. J. App. filed Feb. 25, 1908. Automatic regulation to reduce the lag in compensatory storage-battery systems of distribution.

1,009,311. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed May 4, 1908. Regulation of alternating current systems having storage-battery compensatory influence.

1,009,317. DETECTOR FOR WIRELESS SIGNALING APPARATUS; M. B. Johnson, San Antonio, Tex. App. filed Oct. 6, 1910. Has a spring clip for holding a suitable mineral and an adjustable screw.

1,009,338. AUTOMATIC GAS-PRESSURE ALARM; E. R. Perkins, Cleveland, Ohio. App. filed Jan. 7, 1908. For gas furnaces.

1,009,345. ELECTROMAGNETIC SIGNALING INSTRUMENT; S. H. Sauvé, Denver, Col. App. filed June 18, 1910. A bell has a freely movable ball armature striker.

1,009,354. APPARATUS FOR HEATING WATER; A. Trepreau, Joinville-le-Pont. France. App. filed Feb. 18, 1911. A heating coil around a water coil in a casing.

1,009,357. COMBINED TROLLEY-POLE BASE AND CATCHER; H. E. Vail, Salt Lake City, Utah. App. filed Feb. 7, 1911. Has a lock to hold the pole in case of jumping.

1,009,370. AUTOMATIC ELECTRIC COUPLING MECHANISM; M. Wuerpel, St. Louis, Mo. App. filed April 17, 1907. For use with M. C. B. couplers or independently. (See Patent No. 827,988.)

1,009,386. EXPLOSION CIRCUIT-BREAKER; H. P. Davis and F. W. Harris, Wilkinsburg, Pa. App. filed Nov. 30, 1908. One terminal is a projectile adapted to be driven from a tubular terminal by explosion.

1,009,401. ELECTRICAL PULL SOCKET; E. H. Freeman, Trenton, N. J. App. filed June 2, 1911. Spring and block snap switch for incandescent lamps.

1,009,476. CIRCUIT CONTROLLER; J. P. Coleman and P. Utne, New York, N. Y. App. filed March 10, 1911. Automatically reversible motor drive, the controller drum being raised by two counterweights.

1,009,494. VAPOR RECTIFIER SYSTEM; S. Ferguson, Schenectady, N. Y. App. filed Sept. 25, 1905. Resistances and reactance connected in circuit to bridge the no-voltage interval.

1,009,518. MAGNET FRAME FOR MAGNETO-GENERATORS; G. Honold, Stuttgart, Germany. App. filed July 7, 1910. The pole pieces are held together by the frame without screws or pins.

1,009,549. ELECTRIC COOK STOVE; E. Moss, Kingsburg, Cal. App. filed Aug. 14, 1911. Separable heating and cooking chambers have vacuum walls.

1,009,559. FURNACE FOR TREATING SULPHIDES, PHOSPHIDES, ETC., IN ATMOSPHERES OF VARIOUS GASES; S. Peacock, Chicago, Ill. App. filed Sept. 19, 1910. Inclined rotary furnace body with a helical resistor.

1,009,565. INCANDESCENT-LAMP SOCKET; C. D. Platt, Bridgeport, Conn. App. filed Dec. 20, 1910. Pull switch with toothed contact carrier.

1,009,566. CHAIN GUIDE FOR PULL SOCKETS; C. D. Platt, Bridgeport, Conn. App. filed Dec. 23, 1910. One-piece sheet-metal guide and bracket.

1,009,608. ELECTRODE; E. Weintraub, Lynn, Mass. App. filed June 2, 1911. Flexible braided wire sheath filled with pieces of magnetite.

1,009,611. VALVE-OPERATED MECHANISM; G. J. Wittmann and P. E. King, Newburgh, N. Y. App. filed Sept. 27, 1909. An electric motor for opening and closing gate valves and limiting switches.

1,009,614. INCLOSED FUSE; G. Wright and F. H. Weston, Schenectady, N. Y. App. filed June 21, 1911. A tubular fusible member and connectors soldered at the ends.

1,009,625. ELECTRIC FURNACE; W. C. Arsem, Schenectady, N. Y. App. filed Aug. 18, 1909. A jacketed vacuum furnace with vaporizing and condensing chambers.

1,009,636. APPARATUS FOR USE IN THE DISTRIBUTION OF ELECTRIC CURRENTS; G. Berry, West Drayton, England. App. filed May 6, 1911. A main transformer and a spare transformer, with an auxiliary transformer connected in series with the latter, are connected in parallel across a system.

1,009,637. STREET-INDICATING DEVICE FOR TROLLEY SYSTEMS; W. C. Bisell. Wardner, Idaho. App. filed Feb. 19, 1910. Device on the wire to coact with the trolley pole to close a circuit.

1,009,643. SPARK-PLUG PROTECTOR; A. R. Bullock, Cleveland, Ohio. App. filed Feb. 29, 1908. A projecting skirt to keep out water.

1,009,648. ELECTRIC SWITCH; W. H. Chambers, Baltimore, Md. App. filed May 20, 1907. Pivoted blades with a reciprocating operating handle and toggle connections.

1,009,659. ELECTRICAL ATTACHMENT PLUG; W. C. Fellows, Philadelphia, Pa. App. filed Dec. 22, 1910. Two-part porcelain with split clamping bushing.

1,009,661. ALTERNATING-CURRENT MOTOR STARTER; W. H. Gaulke, Milwaukee, Wis. App. filed Oct. 19, 1910. Special form of holding lever or catch.

1,009,666. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Greenwich, Conn. App. filed Feb. 25, 1908. The booster field in a storage-battery compensating system is energized by alternating current.

1,009,689. TELEPHONE INSTALLATION; A. Pictet, Geneva, Switzerland. App. filed Sept. 9, 1911. An advertisement is automatically spoken over the line while the subscriber is waiting.

13,316. (Re-issue.) ELECTROLYTIC PROCESS OF PRODUCING COMPOUNDS; C. E. Acker, Ossining, N. Y. App. filed Sept. 14, 1911. Producing cyanides and cyanamides from NaCl, etc. Original Patent No. 914,100.